

Marine Environmental Quality Committee

Administrative Report

1978

by A.D. McIntyre

Belgium

(P. Hovart)

1. The effects of dumping industrial wastes along the Belgian coast on the fish and shrimp stocks and invertebrates were further studied.

The monitoring programme was carried out on two dumping areas for industrial wastes derived from titaniumdioxide processes, one area for wastes from the production of thiocarbamates, one area for wastes from the production of proteolytec enzymes and one area for an industrial waste containing 1.5% phenol.

The samples were taken on a two monthly basis by means of a research vessel. A biological and physico-chemical survey was carried out.

2. The monitoring programmes on heavy metals in fish and shrimps were continued. Samples of cod, plaice, flounder and brown shrimps from the Southern North Sea were analysed for Hg, Cu, Zn, Pb, Cd, Cr. The study on the evolution of mercury in Solea solea in the North Sea and the Irish Sea was continued.
3. One toxicity test on wastes of the production of hydroxythyl-cellulose was carried out in accordance with the Oslo Convention.
4. A bimonthly biological and physico-chemical monitoring of the Northern part of the Kwinte Bank, Buiten Ratel and Oostdyckbank where sand extractions are taking place was continued.
5. The regular monthly survey carried out to assess the general state of the marine environment was set forth in 1978. Samples were taken and experiments are performed in a 20 stations network (see report 1977).

The following parameters were measured:

5.1 General oceanography:

Temperature, salinity, turbidity, plant pigment by fluorimetry and spectrophotometry, dissolved oxygen, transparency, meteorological observations.

5.2 Cycle of biogenous elements:

Dissolved nutrients (NO_3^- , NH_4^+ , PO_4^{---} , SiO_2) BOD_5 , biomass and/or numbers and respiratory and/or uptake activities of phytoplankton, zooplankton, heterotrophic bacteria.

5.3 Cycle of pollutants:

Heavy metals (Zn, Cd, Pb, Hg) dissolved and particulate.

6. A grid of 80 stations (covering the same area as the regular survey network) was sampled once for hydrographical (T, S ‰) and biological parameters (chlorophyll, zooplankton). The main purpose of this program is to gain an insight into zooplankton patchiness.
7. A more coastal network of 18 stations was covered on one occasion. The program concerns taxonomy, diversity of benthic fauna and their relationships to environmental factors.
8. Twenty coastal stations and nine stations of the monthly survey grid were sampled on seven occasions for fecal bacteria in water and sediments.
9. The diffusion of plaice eggs and larvae was followed between 31 January and 16 February on a profile extending to the light-vessel "Noord Hinder" (see CM 1978/C:55, Hydrography Committee, ICES).
10. Special cruises were organized to improve the knowledge of the distribution, the speciation and transformation rates of the organic matter present in the marine environment (bacterial uptake, stocks of small organic substrates and turnover times, phytoplanktonic excretion, etc. . .)
11. The monitoring programme on the Scheldt has been continued. Regular monthly surveys were made in 36 stations in order to provide longitudinal profiles of physico-chemical parameters (salinity, temperature, dissolved oxygen, redox potential, pH, turbidity), to study sedimentation processes and heavy metal transport mechanisms, as well as nutrient interactions and bacterial activity.

CANADA

(J.F. Uthe)

Pollution Chemistry

1. Studies of the distribution, behavior and transport of trace metals, particulate organic carbon, and nutrients in the estuary and Gulf of St. Lawrence have been continued. Baseline distributions of organohalogenes, petroleum hydrocarbons, trace metals and nutrients in seawater of Baffin Bay and the eastern Canadian Arctic have also been investigated (BIO)

2. A project in St. Georges Bay, Nova Scotia, Canada deals with the roles of advection and atmospheric input as routes by which organochlorines enter the system: correlations between sedimentation rates, mean currents measured by moored current meters, and direct determinations of organochlorines in sedimenting material will be used to infer the importance of each route. (MEL)
3. Bio-geochemical studies of Zn, Cu, Pb, Co, Ni, Cr, Vi, As, Se and Cd in the sediments of the Bay of Fundy were undertaken in 1979. The data will be used to determine the baseline metal levels, the potential bio-availability of the metals, and the carriers and pathways by which the metals have entered the sediments from natural and anthropogenic sources. Preliminary results indicate most of the metals are presently at or near natural levels. In spite of this, the influence of industrial inputs on the levels of the metals has been detected and this might lead in the future to contamination of the sediments by some metals. (MEL)
4. The dynamics and effects of organic pollutants, including organochlorines and petroleum hydrocarbons have been studied. Laboratory studies of the kinetics of uptake and clearance of organochlorines in zooplankton of different sizes have led to the development of a predictive model of organochlorine accumulation. Feeding studies have been completed which have allowed calculation of the efficiency of retention of organochlorines from food. These lab studies are being complemented by a field study of organochlorine residues in samples of logarithmic size classes of zooplankton (which roughly approximate a marine food chain) in St. Georges Bay, N.S. The intention is to construct a model of organochlorine cycling in the marine food chain, knowing zooplankton life cycles, food consumption, and extent of contamination of food and ambient water. (MEL)
5. Two 300-lb batches of Eastern Canadian herring (Clupea harengus) oil were subjected to pilot plant processing to margarine stock for edible use. Samples were taken at various stages during processing for analysis of residues of the insecticide DDT and its metabolites DDD and DDE, of polychlorinated biphenyls (PCBs) and of dieldrin. Residue concentrations in the oil were not affected by degumming (phosphoric acid wash) alkali refining, or bleaching with activated earth. DDT and dieldrin were readily and completely destroyed by commercial hydrogenation over Ni catalyst, and DDD was largely removed at the same time. DDE and PCBs were partially reduced during hydrogenation in the one run in which DDD was completely removed, but were unaffected in another run, in which DDD was only partially removed. Deodorization of the oil with steam and vacuum effectively removed those residues which survived hydrogenation. Analysis of the Ni catalyst before and after hydrogenation showed that removal of residues during hydrogenation was not due to their adsorption to the catalyst, but was more probably due to metal-catalyzed degradation to unidentified products. Deodorizer condensates showed only a slight enrichment in residue levels over those found in the oil. (MEL).
6. A number of seaweed samples (dulse and kelp) as prepared for human food use were assayed for heavy metals. In $\mu\text{g/g}$ the following range were found (As=5.5-7.5, Cd=1.1, Cu=3.9-6.3, Pb=0.7-3.5, Se=2-2.9, Zn=57-84). (H)

7. The 1978 bloom of Gonyaulax began in early July, peaked in late July and terminated in early August. A field study of the toxin content in various sized plankton fractions was conducted as for 1977. Toxicities on July 26, at the peak of the bloom, were 624, 15 and 60 μg toxin per g plankton in the 20, 64 and 243- μm fractions, respectively. Curiously, toxicity in the 243- μm fraction was greater than in the 64- μm fraction. Also, unlike in 1977, no toxicity was measurable in the 571- μm fraction. This may have been artifactual, because there was very little sample material, requiring considerable dilution for toxin assays. Cell counts at regular intervals revealed that the bloom off Head Harbour was not confined to surface waters. The pattern of rise and fall in Gonyaulax numbers was similar at 10, 20, and 30 m to that at the surface. Even just off the bottom (90 m) there was a considerable number of cells. These observations on Gonyaulax distribution during the bloom attest to the pronounced turbulence in the Bay of Fundy and explain why Gonyaulax, in blood concentrations, do not accumulate in localized areas in this region to form "red tides." (S.A.)
8. PAH concentrations in new lobster eggs from freshly caught Grand Manan, New Brunswick lobsters were 0.017, 0.020 and 0.023 pyrene units/ μg /mL of lipid. Eyed eggs from freshly caught Grand Manan lobsters had a higher concentration, 0.042 pyrene units/ μg /mL.
9. Sediment samples from 10 fish-processing sites, 3 control sites and 2 boating sites in Southwestern Nova Scotia were analyzed for polychlorinated biphenyls (PCB's) and total volatile solids (TVS). At 9 of the fish-processing sites PCB levels were elevated with respect to those at the control sites. In most cases the elevation appeared to be attributable to the discharge of fish waste from fish plants rather than to associated boating activities. From the PCB levels encountered and an observed relationship between PCB and TVS data, it is considered unlikely that PCB levels much in excess of 100 ppb can be attributed to normal fish-processing activities. Contamination of sediment was hypothesized to result from the retention of PCBs by otherwise decaying fish wastes and in some cases from spills of PCB. Contamination outside herring processors was generally greater than outside groundfish processors. The highest level found, 517 ppb Aroclors 1254 and 1260, was thought to be due to gross contamination by fish processing wastes. (E.P.S.)
10. A new source of PCB input into the aquatic environment has been discovered, from a hydroelectric power plant at Churchill Falls, Labrador, where PCB have been used most probably as dielectric fluids in transformers. Fish (burbot and lake trout) taken upstream have been shown to contain PCB in amounts of about 0.5 μg /g wet weight in liver and mesentory fat respectively, approximately 2-6 times less than the amounts in marine fish from the Canadian east coast. However, fish taken immediately downstream (from the "tail race") contain up to 35 μg /g PCB wet weight in liver (mean value approx. 17 μg /g). (H)
11. Individual lobster digestive gland (Homarus americanus) collected from the Atlantic coast of Canada have been analysed for Cd, Zn, Ag, Se, Mn, As, Fe and Cu. In addition lobster claw muscles and rock crab (Cancer irroratus) digestive glands, blue mussel (Mytilis edulis) various tissues were also assayed. A large, highly significant relationship was observed between Ag and Cu concentrations in all crab and lobster tissues examined. The tight relationship observed with Ag and Cu along with the wide range in levels of these two elements is surprising since Cu is biologically active in crustacea and Ag has not been shown to have a biological role in any species. The three species are being studied in depth to assess their role and the interpretation of the results of use of these animals as indwelling water monitors (eg "Mussel Watch"). (H).

POLLUTION DYNAMICS

1. During 1978, research effort in the upper Bay of Fundy was expanded considerably. A tidal power installation has been proposed for this macro-tidal region which has waters with high suspended sediment loads. One of the objectives of this program which is being conducted in cooperation with physical oceanographers and sedimentologists, is to predict changes to the marine ecosystem if the tidal power project is built. The general scientific approach being followed is to measure the existing flux of organic carbon and nutrients in and between intertidal mudflats and coastal waters with the goal of constructing energy flow models in a few years time. (MEL)
2. Epibenthic algal production and community metabolism in intertidal sediments in Minas Basin, the Bay of Fundy were measured each month during 1978. The observations, along with measures of plant pigments, organic matter in surface sediments and macrofauna biomass contribute to an environmental study to assess the magnitude and direction of organic matter flux to and from intertidal sediments. The production dynamics of these exposed sediments, in terms of organic matter synthesized by algae and transformed by fauna, are of interest since possible construction of a barrage for tidal power development will diminish the present extensive area of the intertidal zone behind the intended site. (MEL)
3. The dynamics of metabolism and clearance of petroleum hydrocarbons from the molluscs Mya and Patella are being studied. (MEL)
4. About 130 exploratory oil wells have been spudded off the east coast of Canada since drilling first began in 1966. No environmental assessment has been conducted for any of these wells, which are located between the Canada-US boundary and 60° N since it is not the policy of the Canadian government to require them in this zone. Offshore exploration activity is expected to increase in 1979. One proposed well will set a new world-wide depth record if drilling commences at the planned depth of 1500 m of water. (EPS)
5. The quantity of oil spilled from vessels close to the Canadian Atlantic coast fell from a reported 890,500 L in 1977 to 405,500 L in 1978. Spills of oil from land-based sources in Atlantic Canada rose from 1,071,900 L in 1977 to 1,235,700 L in 1978 but most of this amount was cleaned up before it reached the sea. (EPS)
6. The potential for marine clams (Mya), mussels (Mytilus) and freshwater bivalves (Anodonta) to accumulate fenitrothion was investigated in laboratory studies. Fenitrothion has a relatively low uptake rate constant and a relatively high excretion rate constant and the accumulation coefficient for these species is low. Consequently there is little or no danger of shellfish contamination from a normal application of fenitrothion. Some freshwater clam samples, collected by J.W. Saunders' field crew during the 1978 forest spraying operation near Palfrey Brook, were analyzed. One set of four clams showed a fenitrothion concentration of 0.014 ppm wet weight. Fenitrothion was not detectable in three other sets.

7. To obtain information on background levels, Nereis ranging in size from 1.4-21.4 g, freshly collected from Deer Island, N.B., were analyzed for six chlorinated hydrocarbons. There was an inverse relationship between concentration and worm size for PCB (6-49 ng/g), dieldrin (0.2-1.2 ng/g). DDT (0.3-1.0 ng/g) and DDD (0.3-1.0 ng/g). Results for DDE (0.5-13.0 ng/g) and hexachlorobenzene (0.1-2.2 ng/g) showed a considerable variation with the size of the animals.
8. The uptake and excretion of cadmium by Nereis was explored. Cadmium concentration in Nereis exposed to spiked sediments (1-4 ppm Cd) increased with exposure time, no equilibrium being indicated by 24 days. Small worms accumulate more Cd per unit than larger ones and the concentration within the worms increases with increasing exposure concentration. There is practically no excretion of Cd by Nereis during 75 days in clean conditions. Uptake of Cd by Nereis appears to be primarily from Cd in the aqueous phase. (S.A.)
9. The potential for food chain accumulation was explored by feeding lobsters with mussels spiked with 1.75 and 16.8 ppm PCB (measured concentration) at the rate of 10 g/wk/450-g lobster. After 6 weeks of feeding, maximum average values of 10 and 40 ppm PCB, respectively occurred in lobster hepatopancreas tissue. When fed clean food, PCB concentrations in hepatopancreas tissue returned to initial values in about 6 weeks. (S.A.)
10. Tests with 0.5 and 3 g Crangon exposed to sediment with 0.13 ppm PCB for 32 days showed that smaller shrimp accumulate more PCB per unit wt than larger ones. Concentration factors ranged from 3.5 for 0.1 g to 1.9 for 3-g Crangon. For comparison, the concentration factor for 3-g Nereis is about 5 indicating greater accumulation by Nereis.
- [Equation $Y = 0.487 - 0.089X$, $r = 0.96$, where Y is PCB concentration in shrimps in mg/kg wet wt, X is Crangon wt in g]. (S.A.)
11. A laboratory study of the accumulation and excretion of brominated benzenes by juvenile Atlantic salmon, prompted by the different behaviour of hexachloro- and hexabromobenzene, is completed. The accumulation coefficients of dibromobenzenes are relatively low, those of tri- and tetrabromobenzenes are fairly high. The results indicate that hexabromobenzene is very likely the only compound of this series, not accumulated by fish, due to its extremely low water solubility. (S.A.)
12. A study of the uptake and distribution of ^{14}C -2,2', 4,5,5'-pentachlorobiphenyl by juvenile Atlantic salmon from fresh and salt water was carried out in cooperation with M.Th.M. Tulp (University of Amsterdam). Osmoregulation affects the uptake and the fish accumulated more of this pentachlorobiphenyl from fresh water than from sea water. Some of the results are currently in preparation for publication.
13. Uptake of PCB's by Nereis. The uptake of Aroclor 1254 from spiked sediments by Nereis was studied to examine relationships between uptake and exposure time, worm size and PCB concentration in the sediment.
- (a) Uniform sized worms (3-4 g) exposed to sediment with 0.58 ppm PCB, accumulated 3.5 ppm PCB during 32 days with no indication of an equilibrium concentration.
[Equation $Y = 0.04X + 0.394$, $r = 0.98$, where Y is PCB concentration in worm in mg/kg wet wt., X is time in h]

- (b) Tests with 0.5 to 4.5 g worms in sediment with 0.17 ppm PCB for 32 days showed that smaller worms accumulate more PCB per unit weight than larger ones.
[Equation $\ln Y = 0.336 - 0.477 \ln X$, $r = 0.96$, where Y is PCB concentration in worms in mg/kg wet wt. X is worm wt. in g].
- (c) Uniform sized worms (2-4 g) exposed to sediments with 0.03 to 0.58 ppm PCB for 32 days showed a straight line relationship between PCB concentration in sediment and in worms. Those exposed to sediment with 0.03 and 0.58 ppm PCB contained 0.1 and 3.5 mg PCB/kg wet wt., respectively.
[Equation $Y = 0.048 + 5.98X$, $r = 0.99$, where Y is PCB concentration in worms in mg/kg wet wt., X is concentration in sediment in mg/kg dry wt.].

Excretion of PCB from Nereis is slow. Large worms (7-9 g) with initial concentrations of 0.25 to 1.5 ppm PCB showed practically no change in PCB concentration during 20-26 days in clean sediment. Small worms (3 g) with 1.75 ppm PCB showed no change in 9 days. A slow or negligible excretion rate is consistent with the observations that equilibrium concentrations were not detected in the previous uptake studies. (S.A.)

14. Multiple linear regression analysis of contaminant levels (As, Se, Cu, Hg, Pb, Zn, Cd, PCBs, DDT and HCH) in liver and white muscle from a length stratified sample of an Atlantic cod (Gadus morhua) population from the Gulf of the St. Lawrence indicated that in general the most significant predictors, of contaminant level were levels of other contaminants. Only in the case of arsenic did the level in liver or muscle predict the level in the other tissue. (H)

15. The livers, edible muscle, head kidneys (adrenal homologues) and gonads of male and female cod at various stages of sexual maturity having been fed PCB at 1, 5, 10, 25 and 50 µg/g of diet for approximately 5½ months have been analyzed for PCB uptake and distribution. Preliminary analysis of the results indicates that of the tissues studied, all except gonads display fairly good linear relationships between dietary level and tissue concentration. The atypical behaviour of gonadal uptake was partly explained by the degree of sexual maturity of the fish: levels in immature and mature females, for example, varied by an order of magnitude. (H).

BIOLOGICAL EFFECTS OF POLLUTION

1. Aryl hydroxylase induction appears to play no part in the adaptation of fish to oil pollution. Fish induced by petroleum do not excrete polycyclic hydrocarbons or other AHH substrates more quickly than non-induced animals. (S.J.)
2. Both the uninduced levels and the inducibility of aryl hydroxylases vary dramatically with the phase of the reproductive cycle in the species of fish so far examined; this compromises the utility of AHH as an environmental monitor. (S.J.)
3. Mutagenic activity has been detected in waste crankcase oils, decaying matter, and in a number of chlorinated wastes; all of these may represent significant inputs of mutagens into the marine environment. (S.J.)
4. The mechanisms of toxicity of surfactants and probably other gill irritants is via their action on a receptor on the gills, causing vasal constriction in the gills and blood pressure changes which lead to death. (S.J.)

5. Studies are underway on the sub-lethal effects of both organochlorines and petroleum hydrocarbons on marine biota. Effects studied include changes in enzyme activity, especially in the mixed function oxidase detoxification system and in osmoregulatory enzymes in both fish and molluscs; among the organochlorines studied are a series of PCB replacement materials. Other sub-lethal effects which are being studied include the mutagenic potential of petroleum hydrocarbons on predation on algae by zooplankton. (MEL)

6. To investigate permissible concentrations under the ODC Act, the lethalities of 8 chlorinated compounds to Crangon were determined by exposing the animals to spiked sediments. Based on average measured concentrations, the 96-h LC50's for water exposures (mg/L) done previously at 20°C, and for the sediment exposures (µg/g dry wt) at 10°C are as follows:

Hexachlorobenzene 5, 0.3; Aroclor 1254 0.085, 2.5; Aroclor 1242 0.03, 0.8; chlordane 0.002, 0.13; dieldrin 0.001, 0.005; DDT 0.001, 0.04; endosulfan 0.004, 0.01; and endrin 0.0004, 0.004.

Tests with water exposures at 10°C with 4 of the compounds indicated that the lower temperature caused no appreciable change in 96-h LC50, permitting comparison of results from the water and sediment exposures. Based on measurements of 3 of the compounds (dieldrin, chlordane, endrin) in sediments, interstitial water and surface water during tests, it appears that the toxicity in the sediment tests is related to the concentrations existing in the water phase. (S.A.)

7. The lethality of creosote to larval and adult lobsters and to Crangon was determined. The 96-h LC50's were 0.02 mg/L for lobster larvae at 20°C 1.76 µg/L for adult lobsters at 10°C, and 0.13 and 0.15 mg/L for Crangon at 10 and 20°C, respectively. Creosote accumulated in lobster hepatopancreas, the concentration increasing both with exposure time and exposure concentration. (S.A.)

8. Lethality tests with fenitrothion showed that the 96-h lethal threshold (96-h LC50) was less than 4 µg/L for the shrimp, Crangon, approximately the 96-h LC50 of 1 µg/L for larval and adult lobsters determined previously. On the other hand, marine bivalves (clams and scallops) were not killed in 96 h by concentrations of fenitrothion up to 300 µg/L. (S.A.)

9. Manganese. The 96-h LC50 is approximately 10 ppm. Uptake and excretion studies have been conducted at 0.1, 0.2, 0.5 and 1.0 ppm. On a whole fish basis, manganese was not accumulated by the fish. At 0.2 ppm an equilibrium level of 15 ppm manganese in the fish was reached (control fish 9 ppm). Equilibria were not attained at 0.5 and 1.0 ppm. The concentration of manganese in the fish was 27 ppm (32 days) and 23 ppm (10 days), respectively. The excretion of manganese from fish placed in clean water is relatively fast, with most manganese being excreted within 24-48 h. (S.A.)

10. To complete a study on toxicity of heavy metals to several marine invertebrates, the lethality of Cd and Zn to Crangon and to clams (Nya) and the lethality of Cu to Crangon was measured. Lethal threshold based on 240-h exposures for copper to Crangon was 2.23 ppm. The lethal threshold for cadmium to Crangon was .1 ppm and to clams was 7 ppm. The threshold for zinc to Crangon was 3 ppm and to clams was 7 ppm.

11. The intraperitoneal LD50 of Gonyaulax toxins (0.1NHCl extract) to herring was determined to be 11 ± 5 $\mu\text{g/kg}$ body weight ($p=0.05$), which is similar to that for mammals. Because of the uncertainty regarding the exact structural form of the toxins as they would enter a herring's stomach in nature, determination of the i.p. LD50 of aqueous Gonyaulax extracts (in pH 6.8 buffer) have also been made. The LD50 is nearly the same cis with the acid extracts. The i.p. LD50 of pollock appears very close to the same level, again with both the acid and neutral toxin extracts. It may be that all vertebrate nerves are nearly as sensitive to the toxin, and that differential sensitivity of vertebrates to the toxin depends solely on the degree of absorption in the alimentary system. (S.A.)
12. Dinoseb is a widely used topkiller in eastern Canada. Concentrations likely to affect marine phytoplankton in receiving waters were unknown. The growth rate of six species of marine microalgae (Biddulphia aurita, Chacloceros septentrionale, Phaeodactylum tricornutum, Porosira glacialis, Thalassiosira nordenskioldii, and I. pseudonana) was measured fluorometrically in the presence of the dinoseb at 0, 0.1, 0.5, 1.0, 1.5, and 2.0 mg/L. Compared to controls, there was no effect at 0.1 mg/L on any of the algae. The lowest concentration of dinoseb that completely inhibited growth was 1.0 mg/L for all six species. These experiments suggest that deleterious effects of dinoseb on natural populations of marine phytoplankton can be expected at concentrations between 0.1 and 1.0 mg/L. (S.A.)
13. Work was initiated on the toxicity of bis-(tri-n-butyl) tin oxide, (TBTO) an anti-fouling agent, a marine wood preservative agent and pesticide to lobster. This compound is toxic to 4th stage lobster larva at approximately 1 $\mu\text{g/L}$. Work on toxicity is continuing and attempts are underway to develop satisfactory residue methodology for TBTO. (H).
14. A study was continued on the effects of feeding PCB's (1-50 $\mu\text{g/g}$ diet) to Atlantic cod (Gadus morhua) for 5.5 months. An altered steroid hormone metabolism was found in both testes and intervals at all exposure levels generally stimulating hormone synthesis at the lower doses and impairing synthesis at the highest levels. Abnormal metabolites were also found. Prominent structural changes were also demonstrated in gills, liver and gonads of the treated fish, the severity of which generally increased with increasing dose levels. Normal spermatogenesis was not found in exposed fish while controls ripened normally. Levels of PCB's in exposed fish ranged from approximately 2 to 100 times control fish levels. (H)

Denmark

(A. Nielsen)

The Marine Pollution Laboratory, National Agency of Environmental Protection, has continued the monitoring program, which was initiated by The Beltproject in 1973. The laboratory has further developed the program so that samples of flounder, Mytilus edulis, water and sediments from now on will be collected each year in all Danish waters for determinations of heavy metals and pesticides. Also the laboratory facilities have been improved and in consequence of this the research in relation to scope for growth has been intensified.

The Department of Aquatic Pathobiology, The Royal Veterinary and Agricultural University, has continued the study of a possible direct or indirect interrelationship between pollution of sea water and the occurrence of fish diseases especially the ulcus syndrome. The investigations were initiated in 1975 and will be continued in 1979 and 1980. Preliminary results of the project are given in the ICES papers C.M. 1978/E:28 and E:29.

The Institute of Ecology and Genetics, University of Aarhus, has concentrated the research work on studies in relation to microbial element cycling of sulphur and nitrogen in marine sediments and experimental and theoretical studies on the distribution pattern of selected marine invertebrates.

Greenland (P. Johansen)

Monitoring studies at a disposal site for tailings from a lead-zinc mine and mill in West Greenland continued and have been extended to include e.g. the ringed seal and more fish species than earlier. The main component of the monitoring studies consists of measuring the level of lead, zinc, cadmium and copper in sea water, sediments and marine organisms. Baseline studies related to exploratory drilling for oil off West Greenland are being terminated. In 1978 field and laboratory studies concentrated on microbial degradation of oil.

Finland

(P. Tulkki)

During 1978 a statistical study of substances indicating the state of the Bothnian Sea was completed and a corresponding survey of the Gulf of Finland was started. Hydrographical and chemical data were collected from all sub-areas of the Baltic Sea as well as from the coastal waters of Finland.

Pollution load of the Gulf of Bothnia was evaluated in cooperation with Swedish and Finnish water authorities, and the results were published. The load of the Gulf of Finland was also studied in cooperation with the USSR. A comprehensive study was made of the nutrient load of the rivers discharging from Finland into the Baltic Sea. Detailed evaluations for different coastal areas were made by water authorities.

A four-year field project in the Archipelago Sea was completed in 1978. The study consisted of current measurements, hydrographical and chemical studies. Results are used for making decisions on waste water discharge, water construction and other planning in the area.

Distribution of waste waters has been studied in the eastern Bothnian Bay and published in 1978. This survey, which is continuing, elucidated the behaviour of waste water in the surface layer under ice cover in a brackish-water area.

Current measurements were made by the water authorities in three areas of the eastern Gulf of Bothnia in order to study the distribution of pollution and to make decisions concerning water construction problems.

Studies on plutonium and some other radioactive substances were continued in order to monitor their content in water and sediments and to use especially the plutonium content as a means of dating sediments.

The content of mineral oil of the Baltic Sea was determined and the results published during 1978. The activity of ICES has lead to a decision to make a plan of field studies in case of oil accidents in the sea.

Determinations of heavy metals in sediments, water and biota were continued in several laboratories. Also determinations of DDT and PCB were made.

Methods of analysing heavy metals, plant nutrients and oil in sea water were developed, and the international and national calibration of these methods was continued.

Data on heavy metals of sediments in the BOSEX-area were published in 1978. Plankton samples of BOSEX were analyzed to be distributed in the ICES/SCOR meeting in 1979. The rate of sedimentation has been studied using the Po-210/Pb-210 method.

Results of a model study on oxygen balance of the Baltic Sea were published. This work is continuing.

The Finnish scientists actively participated in all fields of the scientific-technological work carried out by the Interim Commission of the Helsinki Convention. The bilateral work between Finland and the USSR and between Finland and Sweden continued. Co-ordinated monitoring programmes were planned for the Gulf of Finland and for the Gulf of Bothnia. Finland has also prepared its participation in the monitoring of the Baltic Sea proper.

France

(No report received)

Federal Republic of Germany

(V. Dethlefsen and G. Hempel)

Monitoring

Seawater

The monitoring program which has been started in 1973 was continued in 1978. Analyses of seawater samples and particulate matter from 23 to 57 stations in the German Bight were carried out for heavy metals and nutrients. In the Western Baltic seawater was analyzed from 18 stations for pesticides, PCBs, petroleum hydrocarbons, oxygen and pH (Deutsches Hydrographisches Institut, Hamburg).

The Cs-137 content and partly that of Sr-90 has been determined in water and bottom samples of the Western Baltic in the region between the Flensburger Förde and the Isle of Fehmarn. Water samples taken monthly from on board of two light vessels within the German Bight were analyzed for their content of Cs-137 and Sr-90 (Deutsches Hydrographisches Institut, Hamburg).

In a sewage sludge dumping area and neighbouring stations oxygen, particulate organic C and N was analyzed.

In January 1978 water samples from 57 stations in the vicinity of the TiO_2 dumping area were analyzed for particulate suspended iron.

59 samples of sediments and suspended solids from the German Bight were analyzed for heavy metals and sedimentologic parameters. 80 one hour hauls were carried out to sample tar balls in the German Bight (Deutsches Hydrographisches Institut, Hamburg).

Marine Chemistry

In January 1978 the distribution of nutrients and pollutants in the German Bight was investigated.

Neutron activation analysis was applied to the measurement of noxious trace elements in seawater. The formation of acute lack of oxygen in the Western Baltic was investigated. Research was performed on remote sensing of pollution by airplane in the German Bight, and on satellite remote sensing of mass concentrations of blue green algae in the Western Baltic (Deutsches Hydrographisches Institut, Hamburg).

Abundance and distribution of petroleum hydrocarbons was investigated in different areas of the Baltic. Development of methods for identification and quantification of petroleum hydrocarbons in sea water absorbed on particles and in biological material was continued. Oxygen and heavy metal budget of the Kiel Bight were investigated. Heavy metals in sea water from different areas of the Baltic were analyzed. Accumulation and transformation of heavy metals in sediments was investigated. Distribution of chlorinated hydrocarbons was analyzed in different areas of the Baltic specially in the Kiel Bight. Investigations on absorption and desorption of heavy metal compounds from surface layers were continued (Institut für Meereskunde, Kiel).

Projects on identification and quantitative analyses of organohalogen compounds in marine sediments and in seawater of the North Sea and selected estuaries were continued (Institut für Meeresforschung, Bremerhaven).

Residues in marine organisms

Residues of heavy metals, organochlorine compounds and hydrocarbons were analyzed in a variety of marine organisms from the North Sea and Baltic (Institut für Meereskunde, Kiel; Bundesforschungsanstalt für Fischerei, Hamburg; Institut für Meeresforschung, Bremerhaven; Staatliches Veterinäruntersuchungsamt, Cuxhaven).

Effects of pollutants on marine organisms

Field studies

Variation of dynamics and productivity of macro-zoobenthos populations were investigated in dumping areas of the German Bight (Institut für Meeresforschung, Bremerhaven). Epidemiological studies on diseases of fishes in these dumping areas were continued (Bundesforschungsanstalt für Fischerei, Hamburg).

Field studies were carried out in estuaries and coastal areas as well as on stations of the open sea to estimate regional and seasonal trends in heavy metal contamination of Mytilus edulis in comparison to contamination of sediments.

Transplantation experiments with Mytilus edulis were accomplished in the Kiel Bight area to analyze the influence of a sewage treatment plant. Furthermore transplantation experiments were made in wadden sea areas to analyze the influence of the tidal exposure on bioaccumulation of heavy metals.

Monitoring stations using Mytilus edulis are developed for monitoring trace elements. Laboratory and field experiments on analyses of correlations between heavy metals accumulation and sublethal toxic effects of Hg, As, Cd, Zn in marine organisms are investigated (Institut für Hydrobiologie und Fischereiwissenschaft an der Universität Hamburg). In situ studies on effects of oil on wadden sea ecosystems were started (Institut für Meeresforschung, Bremerhaven).

Possible correlations between concentrations of pesticides, PCBs and heavy metals in the gonads of Baltic flatfishes and the mortality and percentage of hatch of their offspring were investigated (Bundesforschungsanstalt für Fischerei, Hamburg; Biologische Anstalt Helgoland; Institut für Meeresforschung, Bremerhaven).

The influence of waste water discharge on activity and composition of micro flora in coastal areas of the Baltic, the effect of thermo pollution on microorganisms (bacteria and phytoplankton) in brackish water areas (Kiel Bight) were investigated.

Investigations on plankton in the Baltic were concentrated on the mass abundance of blue algae, on phytoplankton-bacterial correlations in connection with eutrophication (Institut für Meereskunde, Kiel).

Investigations were carried out on effects of industrial wastes on planktonic benthic brackish water ecosystems, on the effects of general stress factors on benthic ecosystems (Institut für Hydrobiologie und Fischereiwissenschaften, Hamburg; Institut für Meereskunde, Kiel) and on purification capacity of marine algae (Institut für Meereskunde, Kiel).

Laboratory investigations

Heavy metals

Toxicity and accumulation of lead and cadmium by marine bacteria in continuous culture systems (Institut für Meeresforschung, Bremerhaven), metalloorgano complexes on marine benthic algae (Institut für Meereskunde, Kiel), effects of cadmium on growth of marine dinoflagellates (Biologische Anstalt Helgoland), effects of molybdane of phytoplankton (Institut für Meereskunde, Kiel), effects of heavy metals on adsorption of glycine by two species of annelids (Biologische Anstalt Helgoland), effects of heavy metals on population dynamics of Tisbe holothuriae (Biologische Anstalt Helgoland), physical chemical behaviour of transuranides and accumulation by marine invertebrates (Biologische Anstalt Helgoland), uptake of lead and chromium by Mytilus edulis (Institut für Meeresforschung, Bremerhaven), dynamics of cadmium in Mytilus edulis, pathways, uptake, storage, retention, excretion, biochemical correlates (Institut für Meereskunde, Kiel), and accumulation of heavy metals in juveniles of dab (Limanda limanda) and plaice (Pleuronectes platessa) (Biologische Anstalt Helgoland; Bundesforschungsanstalt für Fischerei, Hamburg), were investigated.

The development of a sensitive bioassay using larvae of bivalves was continued (Institut für Meeresforschung, Bremerhaven).

Petroleum hydrocarbons .

The uptake of petroleum hydrocarbons by maturing females of flatfishes, the transfer of the hydrocarbons into the egg and effects on the viability of embryos and larvae were tested (Institut für Meereskunde, Kiel).

Organochlorines

DDT and PCB contamination of cods from the Kiel Bight were correlated to lipid contents (Institut für Meereskunde, Kiel), effects of salinity on LC₅₀ and bioaccumulation of lindane in marine organisms (Institut für Hydrobiologie und Fischereiwissenschaft, Hamburg), of pentachlorophenol on Lanice conchilega and the fate of organic pollutants in Mytilus edulis (Institut für Meeresforschung, Bremerhaven) were investigated.

Iceland

(J. Olafsson)

Mussel watch

In order to study possible marine environmental effects of a ferrosilicon smelter which is being built at Hvalfjörður, SW-Iceland, a baseline survey was carried out on heavy metals in Mytilus edulis. In April samples of intertidal mussel populations were collected from 50 locations in southwest Iceland. The metals analyzed for are Hg, Cu, Zn, Cd, Pb, Ni, Co, Mn and Fe. In Hvalfjörður itself mussels were placed early in July into buoyed cages at three locations. Samples from the cages for the study of seasonal variations will be collected by diving throughout 1979 at around 5 weeks intervals.

Metals in sea water

Numerous samples were collected from coastal and oceanic stations for the analyses of heavy metals, namely Hg, Zn, Cd, Cu, Fe and Mn.

Ireland

(Dr. D. O'Sullivan and Dr. M. M. Parker)

A. Department of Fisheries and Forestry, Aquatic Environment Unit.

1. Fish and Shellfish Quality Monitoring.

Monitoring of the levels of six heavy metals in six species of fish and two species of commercial molluscs on a nationwide basis continues. Fish samples are taken at ports of landing in the course of other routine studies while the molluscs are collected from commercial beds.

2. Estuarine Water Quality Surveys.

Five estuaries or bays on the south and west coasts have been examined. Hydrographic parameters, primary productivity, and organic loadings have been assessed, together with heavy metal levels in seawater, sediments, seaweeds and shellfish.

3. Surveys of offshore dumping sites.

The south coast dumping site (off Cork) for fermentation wastes was surveyed in March and the east coast (Dublin Bay) sewage sludge site was surveyed in April. Water, sediment, and benthos in these areas were sampled on a pre-arranged grid. The data are currently being worked up.

4. East Coast Survey.

A survey of the benthos and sediment chemistry, and of the feeding of young plaice, in the nursery grounds between Howth Head and Clogher Head on the east coast was commenced, as part of a study of the impact of pollution in the north-western Irish Sea.

B. Other Research

1. Carnsore Base Line Survey.

At the instigation of the Electricity Supply Board, a baseline survey is being carried out in the region of Carnsore Point, which has been chosen as a potential site for a nuclear power station. A team from University College, Dublin (Department of Zoology) are engaged in quantitative surveys of the rocky and sandy littoral, and of inshore plankton and young fish; concurrently, studies of records of commercial and game fish and shellfish from this area are being carried out. University College, Galway (Zoology Department) is engaged on a survey of the offshore soft benthos and University College, Cork (Botany Department) has carried out a survey of littoral macro-algae.

2. Dublin Bay Study.

A multi-disciplinary team from Trinity College, Dublin are completing research in Dublin Bay and elsewhere on the East Coast, on the effects of pollutants, particularly heavy metals and nutrients, on the organisms and sediments, with the aim of developing criteria for the assessment of environmental quality in estuaries.

3. Cork Harbour Project.

Teams from the Zoology and Botany Departments, University College, Cork, are undertaking surveys of the benthic fauna and the benthic and littoral flora, in relation to pollution parameters in this industrialised estuary.

4. Bantry Bay.

A littoral and sub-littoral ecological survey is being carried out at selected rocky sites in Bantry Bay by scientists from the Zoology Department, University College, Cork. This is an extension of baseline survey work carried out in this area in the early 1970s.

NETHERLANDS

(S. J. de Groot and J. Duinker)

The distribution of PCBs and pesticides was determined in Dutch inland waters, the mouth of the river Rhine and the North Sea. The PCB contents of eel of the river Rhine and the Meuse were high with an average of 50mg/kg on a fat base, but eel of the areas near the mouth of the Rhine, Hollands Diep and Haringvliet, contained much more PCBs (130mg/kg). Mussels of the coast near Hoek van Holland had higher PCB contents (43-72mg/kg) than those on a distance of 25 km from the coast (7-20mg/kg on a fat base), showing the transport of Rhine water in a narrow strip along the coast of the Netherlands. In the southern part of the North Sea cod livers had PCB contents ten times higher than in the northern part. Since 1974 the PCB content in the southern North Sea increased from 39g to 53 mg/kg (on a fat base).

The oil pollution of the Dutch beaches in the beginning of July 1978 could be ascribed to the "Eline V", the broken Greek tanker partially blown up by the British Authorities on May 30th near Lowestoft.

Biodegradation systems were developed using continuous cultures according to the chemostate principle.

1978 was the 6th year of a phytoplankton monitoring study in a 70 km wide area along the coast of the Netherlands. The diversity indexes are comparable with those of the previous years. The highest diversity indexes occur 70 km from the coast in the spring. After April they decrease with minima in the summer and in August the diversity indexes increase with a gradual decrease of the number of phytoplankton species in September and October.

The recovery of the bottom fauna in a series of dredged sandpits in the western Waddensea (Malzwin) was followed during 1978.

The bottom fauna of the gully had a biomass of about 0.69/m² compared with those of the flats of 1.5 - 3.29/m². It was found that the extraction caused about a 50% reduction in biomass, hence 0.39/m². During the months when normally gradually the amount of biomass reaches its peak, to be followed by a steep-decline in the late autumn, the biomass in the disturbed area reached about 65% of the original value found in April (to). In the deepest pits (about 2.5 m) a fine blackish sediment was deposited with no life in it after several months. During the period investigated there was hardly a change in the amount of fine sediment in these pits, notwithstanding that there are strong tidal currents in the area.

Samples of seal stranded along the coast in the Dutch Waddensea were analyzed for chlorinated hydrocarbons and metals. PCB concentrations (Arochloor - 1260) in blubber, heart, spleen, kidney, liver, ranged from 20-700 ppm on lipid basis. Also mirex Σ p,p' DDT and α HCH, γ HCH and dieldrin were positively identified, in concentrations in the PPM and sub PPM range.

A method was developed that allows very low blank chromatograms necessary in the determination of dissolved and particulate compounds in sea water using relatively small water samples. It was demonstrated that the concentrations of metals in sediments of Rhine-estuary and adjacent coastal area can be interpreted in terms of physical mixing and chemical removal of components from solutions into particulate matter during estuarine mixing.

Norway

(P. T. Hognestad)

Pollution

1. Field Programmes

1.1 Chemical and hydrographic study of the Skagerrak. Observations were made through the Skagerrak on the S, P, nutrient-salts, chlorophyll and trace metals. Forty-five sediments-cores were also obtained to study the trace metal affinity in the sediments and the chemistry of the interstitial water. (Institute of Marine Biology and Limnology, University of Oslo).

- 1.2 Observations on the metal-organic complexes in the water column of the Bonnefjord with special reference to the characterisation of the complexes found in the euphotic, the oxic and anoxic layers. (Institute of Marine Biology and Limnology, University of Oslo).
- 1.3 Trace metal species study in the Drammensfjord with particular reference to the H_2S production. (Institute of Marine Biology and Limnology, University of Oslo).
- 1.4 Chemical changes in the sediment-water interface under oxic and anoxic conditions with special reference to C, N, trace metals and the carbonate/ H_2S systems in inner Oslofjord and Drammensfjord. (Institute of Marine Biology and Limnology, University of Oslo).
- 1.5 Investigations on the environmental qualities in the Skagerrak from Risør to Grimstad were carried out with 10 surveys throughout the year. Measurements were made of temperature, salinity, oxygen and nutrients. (Biological Station Flødevigen).
- 1.6 Continued study in south-eastern Norway. A programme covering baseline study of fish and shellfish productivity in the Oslofjord and adjacent waters was completed in 1978 with 7 surveys after 5 years activity. Hydrography, primary production, phytoplankton, zooplankton, fish larvae and the distribution of fish and shellfish were analysed. (Biological Station Flødevigen).
- 1.7 Investigations of pollution effects in coastal and fjord areas from municipal industrial effluents. The observations include standard hydrography, current measurements, nutrients, metals, halogenated and other organic micro pollutants, chlorophyll, phytoplankton, benthic algae, bottom fauna, fish and sediments according to the particular problem investigated. Analysis of metals and organic micro pollutants in organisms and sediments are carried out in cooperation with The Central Institute for Industrial Research. (The Norwegian Institute of Water Research).
- 1.8 The monitoring of selected fjords as a pilot project for The National Monitoring Programme of the Ministry of the Environment and the monitoring of the eutrophic state of inner Oslofjord have been continued, as well as a study of the physical spreading of sewage from a deep water outlet. Stereophotography of fixed sites for monitoring of hard bottom fauna has been continued in cooperation with The Institute of Marine Biology and Limnology, University of Oslo. (The Norwegian Institute of Water Research).
- 1.9 Bioregistration of heavy metal pollution by benthic algae. The marine algae Ascophyllum nodosum seems promising as a tool for tracing metal in natural waters and changes in concentration may be detected. (Institute of Marine Biochemistry, University of Trondheim).
- 1.10 Levels of oil hydrocarbons in selected littoral species. The structure of boreal hard rock littoral communities seems to be governed largely by the success or failure of a few key species. A study of four key invertebrate species on a hard rock littoral site in the South-West Norway is made to attempt to link fluctuation of oil hydrocarbons in tissues to seasonal fluctuations in lipid content, reproduction, settling success and population structure. (Institute of Marine Biology, University of Bergen).

1.11 Effect of oil hydrocarbons on a shallow-water sandy biotype. Field experiments are being carried out on areas of sea bed isolated for periods of time from their surroundings and subjected to addition of water containing oil hydrocarbons. Preliminary results indicate no drastic effects, greater than natural seasonal variation, at hydrocarbon concentrations of 25-50 $\mu\text{g/l}$. There are signs, however, that exposure to hydrocarbons may effect physiological rates such as photosynthesis and mineralization of hydrocarbons. (Institute of Marine Biology, University of Bergen).

1.12 Investigations on the environmental qualities of selected Norwegian fjords from Oslofjord to Varangerfjord were carried out in November-December. The fjords were selected to represent different types of environmental conditions, fjords with expected industrial loads, domestic loads or "no" expected loads. Measurements were made of salinity, temperature, primary production indices, nutrients and oxygen distribution, turbidity and particulate matter. (Institute of Marine Research).

1.13 Environmental conditions in coastal sea water. This programme continued for the fourth season. The organic load of the Baltic Current is being investigated from the Øresund, through the Kattegat, Skagerrak and along the western Norwegian coast. Continuous measurements are made on particulate matter, nutrients and temperature, whereas primary production indices are measured at regular intervals. (Institute of Marine Research).

1.14 Investigations of oil pollution in Norwegian waters by analysis of selected aromatic and sulfuraromatic hydrocarbons and also determination of total hydrocarbon content in cases of heavy pollution. The following projects have been operated. Monitoring of the North Sea on a section between Fedje and Shetland 5 times, 4 stations each time. Monitoring of Fensfjorden, recipient of waste water from a petroleum refinery, 5 times, 4 stations each time. Petroleum hydrocarbons in sediments and benthos in the Barents Sea. Mussel-watch for petroleum hydrocarbons in Byfjorden, Bergen. Monitoring of controlled discharges of oily waste water from oil installations in the North Sea. (Institute of Marine Research).

1.15 Monitoring of the pelagic tar concentrations in the water off the Norwegian coast from Skagerrak to the Barents Sea. The project is a contribution to IGOS Pilot Project on Marine Pollution (Petroleum) Monitoring under GIPME, Global Investigation of Pollution in the Marine Environment. (Institute of Marine Research).

1.16 Fate and effects of oil hydrocarbons in shallow water sandy area. Marine sediments may act as sinks for oil hydrocarbons, and organisms living in shallow water sediments may encounter hydrocarbon levels which are higher than those of the water above, and which reflect the inputs over a long time. A study of accumulation and biotransformation of oil hydrocarbons in a benthic environment, and the effects on the existing organisms, is made in a long-term experiment, in which oil hydrocarbons are periodically introduced to the water above an artificially enclosed sandy bottom at 8 m depth. (Institute of Marine Research, University of Bergen and Institute of Marine Research, Bergen).

2. Laboratory Assays

- 2.1 Specific biological programmes related to thermal effects were carried out on mortality, growth, food uptake, hatching success and development in commercially important fish and shellfish species. (Biological Station Flødevigen).
- 2.2 Behaviour of cod in water with gradients of the soluble fractions of Ekofisk crude oil was studied in a special constructed aquarium. (Biological Station Flødevigen).
- 2.3 Study of effects of water with soluble fractions of crude oil was carried out on diluted natural populations of phytoplankton and in cultures of single species. (Biological Station Flødevigen).
- 2.4 With financial support from The Norwegian Marine Pollution Research and Monitoring Programme, a new project on sub-lethal effects of the water soluble fraction of crude oil in the flounder was initiated. So far work has been concentrated on the building up laboratory facilities for controlled long-term experiments. (Institute of Marine Biology and Limnology, University of Oslo).
- 2.5 Investigation of the influence of crude oil and oil dispersants are being continued on zooplankton, especially sea-urchin larvae, fish larvae, and copepods. (University of Tromsø, Institute of Biology and Geology).
- 2.6 Routine bioassays include algal growth potential, and fish and phytoplankton tests for acute toxicity. Pollution load of degradable organics, nutrients and other pollutants has been calculated for several fjord recipients, and the effects of environmental stresses from different types of thermal power plants have been predicted. (The Norwegian Institute of Water Research).
- 2.7 A report on the possibilities and problems in recirculation of municipal waste water through biological systems has been finished. A review of sources, levels and effects of halogenated hydrocarbons has been prepared as well as a review of existing data on cadmium and PCB in marine waters, biota and sediments of Norway. (The Norwegian Institute of Water Research).
- 2.8 Accumulation and metabolism of phenanthrene in coalfish (Gadus virens) has been studied using carbon-14 labelled phenanthrene. It was found that carbon-14 accumulated rapidly in the liver, muscle and gallbladder. Seven metabolites of phenanthrene were isolated from the gallbladder and the urine and identified. (Institute of Marine Research).
- 2.9 Comparative accumulation and depuration in blue mussel (Mytilus edulis) and sand mussel (Dosinia exoleta) during long term continuous exposure to different realistic levels of aromatic hydrocarbons extracted from North Sea crude oil. (Institute of Marine Research).

POLAND

(G. Okozotowicz)

In 1978 Polish institutes carried out in the Polish exclusive fishing zone of the Baltic Sea investigations of the following parameters related to water pollution:

Meteorological conditions, wind-driven currents, water temperature, salinity, oxygen concentration, phosphate, total phosphorus, organic phosphorus, nitrate, nitrite, total nitrogen, ammonia, urea, alkalinity, pH, permanganate oxidability, BOD, Hg, Pb, Cd, Cu, Zn, Fe, EDDT, p.p'-DDT, p.p'-DDE, p.p'-DDD, petroleum hydrocarbons, turbidity and water transparency.

In addition, investigations were carried out on primary production and chlorophyll "a", phytoplankton, zooplankton, ichthyoplankton, macrozoobenthos, benthic meiofauna. Experimental investigations on the influence of petroleum hydrocarbons on Crangon crangon were also carried out.

Portugal

(M. E. Mergulhão and C. Lima)

INSTITUTO NACIONAL DE INVESTIGACAO DAS PESCAS, Secretaria de Estado das
Pescas Ministério da Agricultura e Pescas

Study of estuarine processes in the Sado

Objective - to determine the effects of water mixing and movement in the fresh/salt water transition zone on the distribution of chemical parameters.

Studies of phytoplankton in the Tejo estuary.

Studies of physical and chemical parameters of sea water in relation to the spawning and development areas of Sardina pilchardus (W.) on the Portuguese coast between Cabo da Roca and Ponta da Arrifana.

Studies of physical and chemical parameters of sea water round Cape Carvoeiro.

GABINETE DA ÁREA DE SINES, Presidência do Conselho

Quality control studies of industrial effluents in the Sines region.

Study of physical, chemical and biological parameters of water in the coastal zone of Sines.

SERVICO DE ESTUDOS DO AMBIENTE, Secretaria de Estado do Ordenamento Físico, Recursos Hídricos e Ambiente, Ministério da Habitação e Obras Públicas.

Studies of aquatic pollution in the Sado estuary; characterization of the water masses, circulation, dispersion, nutrient salts and levels of toxic metals.

Study of the Guadiana estuary

Field measurements of salinity, temperature, currents, dissolved oxygen, suspended material and nutrient salts.

Study of the impact of the thermal electric plant at Setúbal.

Measurements of physical-chemical parameters of sea water and of biological parameters.

Study of the impact of the thermal electric plant at Aveiro, in collaboration with CNEOX.

COMISSÃO NACIONAL DO AMBIENTE

Environmental study of the Tejo estuary.

CENTRO DE GEOFÍSICA DAS UNIVERSIDADES DE LISBOA, Oceanographic Group

Hydrodynamics of the Sado estuary.

Systematic measurements of currents, temperature and salinity.

Circulation and upwelling in Portuguese coastal waters.

Oceanographic cruises, moored recording current meters and tele-detection of surface currents in the Cabo Carvoeiro - Cabo Mondego and Cabo Espichel - Sines regions.

COMISSÃO EXECUTIVA DO POLÍGONO DE ACÚSTICA SUBMARINA DOS AÇORES, Estado Maior General das Forças Armadas

Tele-detection studies in support of the tunny fishery in Açores region.

Tagus River Estuary, mercury pollution monitoring in water.

Portuguese Beach Estuary, nutrients, metals, non-polar hydrocarbons, E. coli in water and sediments.

Paper mill pollution monitoring of Celnorte paper mill effluent and coastal waters. Mercury pollution monitoring of Aveiro (River Vouga Estuary).

Flores and Sta. Maria Islands (Açores) - inventory of the chemical and biological parameters pertaining to the monitoring of marine pollution in areas of open sea (water).

Madeira Island - Marine pollution monitoring for the evaluation of pollution by dumping of industrial wastes in the areas of Madeira from the North Europe and from the Mediterranean Sea.

• SCOTLAND

(A. D. McIntyre)

1. Shellfish and public health

A service giving advice on purification and for analysis of shellfish and water for selected pollution indicators has been maintained.

2. Sewage

Detailed examination of the hydrographic and biological features of the Edinburgh sewage sludge dumping grounds has continued. The dumping of sewage sludge from the Lothian Region commenced early in 1978 and the follow-up surveys are designed to monitor background levels and possible effects. Experiments on the enrichment effect of sewage sludge on the benthos have continued in underwater chambers.

3. Metals

Intercalibration The DAFS laboratory continued to play a significant role in the ICES trace metal intercomparison programme by preparing and circulating two specially prepared reference samples for analysis.

Monitoring metals in fish and shellfish Measurements of selected heavy metals, particularly mercury and cadmium, in fish and shellfish continued during 1978. These took account of proposals by ICES Working Groups on baseline and monitoring. Studies of mercury levels in relation to size, age and catch area were carried out on blue whiting, dogfish and ling. Routine monitoring of mercury in exported fish and shellfish has continued twice yearly in relation to mercury certification.

Mussel Watch Programme In collaboration with the Torry Research Station, Aberdeen, and the DAFS Freshwater Laboratory, Pitlochry, samples of mussels from about 100 sites around the coast of Scotland were collected as part of a Scottish mussel watch programme.

Studies of the marine chemistry of mercury have continued in the Firth of Forth, an area which exhibits above background levels in the inner part. Once again mussels were placed in moored cages at selected parts of the river estuary to assess changes in mercury levels with time and space.

Experimental Studies During 1978 the large plastic enclosures moored in Thurnaig Bay, Loch Ewe, were used to study the marine chemistry of trace elements; particular attention was paid to settlement material in assessing the rates of transfer of arsenic, lead and cadmium from the water column to the sediments.

Experiments have been done in tanks to determine the effects of mercury and cadmium on the hatching times and subsequent development of the eggs and larvae of plaice and sandeels. Experiments have also been done on the rate of uptake of cadmium by crabs.

4. Oil

Monitoring Monitoring for hydrocarbons in Scottish waters has been planned and executed in collaboration with Torry Research Station, Aberdeen. Attention was mainly focussed on selected estuarine and coastal areas (eg the Firth of Forth and Sullom Voe). Offshore work centered on the measurement of background hydrocarbon levels around offshore installations and in the area between the Firth of Forth and the Forties Field. In collaboration with Torry Research Station, shellfish have been maintained in moored cages in Sullom Voe and examined for possible tainting.

Experimental studies The large plastic enclosures at Loch Ewe were used to investigate the rate of degradation of oil, both naturally and in the presence of a dispersant; and also the effect of oil on the planktonic ecosystem. Experiments in underwater chambers were done to study the rate of degradation of a mixture of weathered oil and sediment placed on the bottom. Experiments were done in tanks to investigate the effect of water soluble fractions of oil on the hatching times and subsequent development of herring eggs and larvae.

Experiments have been started to detect and estimate the amount of activity in fish of the carcinogen yielding enzyme, aryl hydrocarbon hydroxylase.

5. Toxicity testing

Experiments were done to determine the toxicity of various substances in connection with the issuing of licences to conform with requirements for the Dumping at Sea Act 1974.

6. Dredging

Investigations were done to determine the effect on the biota of a major dredging operation in Loch Ryan.

7. Work at Pitlochry

The six-monthly survey of organochlorine residues in cod, whiting, plaice and herring from the Firth of Clyde, Moray Firth, Firth of Forth and Ling (or Viking) Banks was continued through 1978, for the last year. Some sampling will continue in future years in the Firth of Clyde, to follow particularly the trends in PCBs and dieldrin. It is anticipated that the latter will be replaced as a moth-proofing agent by other chemicals, in the hope that dieldrin concentrations in herring can be reduced to values below 0.05 $\mu\text{g}/\text{kg}$.

The organochlorine data from the 1978 mussel survey of the Scottish coast have now been examined, and a paper was presented at the Statutory Meeting in October. Heavy metal analyses in the liver, kidney and spleen of a series of grey seals culled from the Farne Islands in 1975 were completed, and reports on the results of both these and the analyses of organochlorine residues were also presented in October.

Sediment samples from the sludge dumping areas at St. Abbs Head and Bell Rock in the Firth of Forth have been analysed for organochlorine residues, as part of a programme of investigation into the distribution of pollutants in the area. Nine months after dumping began the mean concentrations of dieldrin and total HCH had increased tenfold at the Bell Rock and a significant rise in the HCB concentrations was measured at St. Abbs Head. Other residues measured, including total DDT and PCB, showed no significant change.

Spain

(A. Alvarez)

A monitoring network has been established to study a range of parameters as shown in the following table:

Places Parameters	1) Canarias	2) Vigo	3) La Coruna	4) Santander
Bathythermograms	+	-	-	-
Temperature	+	+	+	+
Salinity	+	+	+	+
pH	+	+	+	-
Dissolved oxygen	+	+	+	+
Suspended matter	+	-	-	-
Chlorophyll <u>a</u>	+	-	+	+
Productivity (C ¹⁴)	-	+	+	-
Nitrates	+	+	+	+
Nitrites	+	+	+	+
Phosphates	+	+	+	+
Silicates	+	-	+	-
Tar particles	+	-	-	-
Coulter Counter counts	+	+	+	-
Zooplankton biomass	+	+	+	-
Dinoflagellate cysts	-	+	+	-
Bacteriology	-	-	-	+

1) The Island of Tenerife, to the east of San Esteban, monthly sampling from 0 to 200 m.

2) Rias of Vigo and Pontevedra, weekly sampling.

3) Rias of Arosa and Muros, weekly sampling.

4) Santander Bay, weekly sampling.

In addition, in the Island of Tenerife, tar particle distribution is studied in 14 littoral beaches.

At the Second International Conference on Toxic Dinoflagellates Blooms (Key Biskayne, Florida, USA) from October 31 to November 5, 1978, the following paper was presented: "A bloom of Amphidinium sp. in the Ria de Vigo (NW Spain)" by F. J. Sanchez and S. Fraga.

In the Instituto de Investigaciones Pesqueras, a number of pollution studies have been carried out and details are as follows:

1) A study has been conducted of biological effects of heavy metals in marine organisms, for example, CH_3Hg^+ on Sparus aurata and Halobatrachus didactylus, and Cu on Mugil auratus, Penaeus kerathurus and Sepia officinalis.

Keeping marine organisms in sea water with sublethal concentrations of CH_3Hg^+ and Cu, Sparus aurata was seen to accumulate Hg in all the organs and tissues studied. The maximum concentration was reached after 80 days in liver and kidney with values of 21 and 23 ppm/wet weight. Similarly, histopathological alterations were studied in different parts of the body. Mugil auratus accumulates Cu in liver (400 ppm after 76 days) where important pathological alterations were produced. Incubation period of Sepia officinalis is affected by Cu and significant concentrations can impede incubation. Biodegradability of commercial anionic detergents has been studied in sea water as well as quantitative influence of Gram(+) and Gram(-) bacteria in it.

2) Oil monitoring and control are being continued in the port and bay of Cadiz. Values go from 30 ppm in outer waters to 100 ppm in the inner parts of the port.

3) Periodic pesticide pollution control is being carried on in different species of intertidal fauna in Galicia and Basque coasts.

4) Biphenyl polychlored, DDT and main lipidic components have been studied in the zooplankton samples from the cruise of "Galicia IV" in order to find possible relations between the composition of the latter and the quantity of those components.

5) In the laboratory of Vigo, experiments have been done to study the bio-accumulation process of PCD in cultures of Skeletonema costatum.

Sweden

(L. Thorell)

DESCRIPTIONS OF PRESENT STATE, EXCHANGE PROCESSES
AND TRANSPORT OF MATERIAL.

Monitoring

With the assistance of Coast Guard Personnel and vessels, routine hydrographical observations are made along the coast of Sweden in a joint project of the National Environment Protection Board, the Swedish Board of Fisheries and the Swedish Meteorological and Hydrological Institute.

Since 1969 chemical and hydrographical observations are made by the National Board of Fisheries in order to study the stagnation of deep water of the Baltic. Research vessels visit the Baltic and the Kattegat four times a year. Data obtained for temperature, salinity, alkalinity, pH, oxygen, phosphate, total phosphorous, nitrite, nitrate, ammonia, total nitrogen, silicate, absorption at 370 nm, hydrogen sulfide and occasionally chlorophyll, oil, urea nitrogen, total organic carbon and tritium.

In studies of the Gulf of Bothnia similar data are obtained twice a year.

Studies of coastal dynamics, exchange processes and patchiness in Swedish waters

(University of Gothenburg)

Fermentation of methane in marine sediments

(University of Gothenburg)

Marine carbonate sedimentology

(University of Uppsala)

The importance of biological material for marine sedimentation

(University of Luleå)

Marine geological investigations in the Baltic and the marine areas on the Swedish west coast

(University of Stockholm)

Nitrogen fixation and photosynthesis in blue-green algae

(University of Gothenburg)

Studies on the nutritional physiology of benthic multicellular marine algae

(University of Uppsala)

THE WEST COAST

Investigations of the balance of water and matter in northern Kattegat

Determination of the balance of water and matter in northern Kattegat and preparation of mixed routines for an outsea monitoring program.

(National Board of Fisheries)

The west-coast project-pelagic

Investigation of the structure and transport of energy within the pelagic ecosystem of the Gullmarsfjord.

(National Board of Fisheries)

Growth and conditions for growth of fish in river mouths

(University of Uppsala)

Molluscs in the northern Atlantic, ecology and taxonomy

(University of Gothenburg)

THE ÖRESUND

Studies of the material balance in the Öresund

Calculation of the transport of material between the Baltic and the Skagerrak within the framework of a joint Danish-Swedish project.

(University of Lund)

THE BALTIC

Transport of material in the Himmerfjärd

Study of hydrographic parameters and the transport of material in the Himmerfjärd in connection with a system-ecological investigation carried out at the Askö Laboratory.

(Swedish Meteorological and Hydrological Institute)

The Åland Sea

Calculation of the transport of material and water between the Gulf of Bothnia and the Baltic Proper in cooperation with the Institute of Marine Pollution in Helsinki.

(Swedish Meteorological and Hydrological Institute)

Hydrochemical investigation in the Gulf of Bothnia

Calculation of the chemical balance in the Gulf of Bothnia by sampling and analysis of hydrographic-chemical parameters in the winter period.

(National Board of Fisheries)

Exchange processes at the sediment-water interface in the Baltic

Investigation of the transport and exchange processes in sediment and near-bottom water of phosphorous, nitrogen,

oxygen, sulphur, hydrogen, iron and manganese by model simulation in the natural environment.
(University of Stockholm)

Investigations on turnover of water in the Baltic and research on physical oceanography

(University of Gothenburg)

Numerical model of the Baltic

Development of a numerical model of the estuarine circulation of the Baltic in order to study physical processes important to the ecosystem.
(International Meteorological Institute, University of Stockholm)

Studies on the precipitation over the Baltic

Determination of monthly values of precipitation over the Baltic 1951-1970 and 1975-1976.
(Swedish Meteorological and Hydrological Institute)

BIOLOGICAL EFFECTS OF POLLUTION

THE WEST COAST

Benthic ecosystems

Study of the effects of changes in water quality on hard and softbottom ecosystems in the Kattegat and the Skagerrak as well as long term dynamic processes within benthic ecosystems.
Study of hard bottoms by SCUBA technique.
(The Kristineberg Marine Biological Station)

The ecosystem of shallow marine soft bottoms

Evaluation of the importance of different shallow soft bottoms as resources of nutrition and study of the causes for differences between an unpolluted and a polluted area.
(University of Gothenburg)

Effects of dredge disposal

Investigation of bottomfauna before and after dredge disposal in a fiord at the west coast of Sweden.
(Swedish Water and Air Pollution Research Laboratory)

Organic pollutions in coastal waters

Survey of the occurrence of lignin and oil in Swedish marine waters. Development of a method to determine aromatic substances in seawater.
(University of Gothenburg)

Ecotoxicological studies in the marine environment

Study of the toxicity of mixtures of heavy metals, surfactants and pesticides for marine animals. Specially sublethal and chronic effects. Influence of salinity and other environmental factors.
(The Kristineberg Marine Biological Station)

Effects of heavy metals on a soft-bottom ecosystem

Study of long-range effects of low concentrations of heavy metals in a model of a soft-bottom ecosystem.
(Brackish Water Toxicology Laboratory, National Swedish Environment Protection Board)

Mechanisms of control and dynamics in the biological turnover of nitrogen in marine sediments and bottom water

Disturbances caused by sedimentation of heavy oils, dumping and dredging.
(University of Gothenburg)

THE BALTIC

Biological monitoring, the Baltic Proper

Study of how the ecosystem in a coastal area of the Baltic is affected by natural and anthropogenic changes in water quality.

Dynamics and energy flow of the Baltic ecosystem. Study of the biomass and the production of phytoplankton, pelagic and benthic organisms and fish. Correlation of findings with data on currents, temperature and chemical properties of the water.
(The Askö Laboratory, University of Stockholm)

Investigation in the Himmerfjärden

Study of the dynamic processes of the pelagic ecosystem on different stages of the production cycle.
Relation of the production of the pelagic ecosystem to the production of the bottom ecosystem and its importance for the oxygen content of the bottom water and the recirculation of nutrients within the system.
(The Askö Laboratory)

Long-range effects of oil pollution in a coastal area

Survey of an oil discharge (Thesis) in a coastal area, in order to give a basis for future decisions on research and reconstruction work.
(University of Stockholm)

Nitrogen fixation in blue-green algae in brackish water

Demonstration of possible changes in the structure and function of the population of phytoplankton, particularly concerning nitrogen fixation, due to discharges of sewage and cooling water.
(University of Uppsala)

Observations of the effects on marine organisms of cooling water from nuclear power plants.
(National Swedish Environment Protection Board)

DEVELOPMENT OF METHODS FOR INVESTIGATIONS

Remote sense analysis of biological-ecological parameters in the aquatic environment

Development of methods for investigations of water quality in environmental and marine ecological research.
(University of Stockholm)

Methods for investigations and classification of marine and brackish ecosystems for planning purposes

Prediction and illustration of the conditions and limitations for different utilization of different investigated areas.
(University of Kalmar)

Production of bacteria in situ

Development of methods to decide the generation time for a population of bacteria. Preparation of routines for interpretations of field results.
(University of Umeå)

United Kingdom

England and Wales

(P. Wood)

Monitoring activities

During the year, monitoring activities have continued with emphasis on particular problems or areas identified previously. However, the core programme of fish and shellfish quality monitoring has been continued. Studies have included attention to fish quality in industrial estuaries, a joint study with ISTPM (Nantes) of fish and shellfish quality of the English Channel, special investigations into accumulated metals in edible crabs from nine commercial fishing areas and in newly exploited species. As part of the mussel watch programme, 100 sites around England and Wales have been sampled, and analysed for heavy metals. A study of dieldrin concentrations in fish, shellfish and sediments from the Humber Estuary has been completed.

In all these studies great importance is given to the quality of the analysis, and during the year, several intercalibration exercises have been undertaken, including three undertaken by the Council: for cadmium and lead in fish homogenate, for trace metals in fish meal, and for organochlorine residues in fish oil.

Hydrocarbon surveys

Continuing use is being made of the GC/MS facility for detailed investigations, although increasing effort is being directed towards the use of UVF methods, and gas chromatography. A survey of existing hydrocarbon concentrations has been made in water and sediment of the Western Approaches of the English Channel, the North Sea and selected estuaries with high inputs of hydrocarbons. In cooperation with CNEXO special studies have been made of hydrocarbons in water and sediments following the "Amoco Cadiz" spill. In addition, the fate of a heavy fuel oil from "Eleni V" stranded at harbour and beach sites off the east coast of England is being made. Selected samples taken for the mussel watch study have been examined for hydrocarbons.

Intercalibration exercises have been held with CNEXO following the "Amoco Cadiz" investigations, and with the Institute of Marine Research, Bergen.

Monitoring of areas used for dumping of wastes

Several of the major areas of disposal were surveyed during 1978, including dump areas in Liverpool Bay, the Bristol Channel, and at two sites in the English Channel. Studies have included sedimentology, the chemistry of sediments, benthic ecology, and the distribution of heavy metals in commercial species. Much data from earlier surveys of the Bristol Channel, the Thames and off the Tees including that from recent surveys, is still being worked up but a series of publications describing earlier work has been prepared, and will be published during 1979. With few exceptions, conditions in the dumping areas continue to be satisfactory, with only local minor changes being observed occasionally. Microbiological tracing techniques employing E. coli have again proved to be highly satisfactory for determining the distribution of settled sewage solids at 4 dumping sites. Studies off the River Tyne showed that estuarine discharges exert a considerable influence on offshore sediments. Other indicators (Cl. perfringens, coliforms, and faecal streptococci) were tested but were not found to offer advantages over E. coli. Studies are being made to improve the recovery of E. coli from sediments.

Mineral extraction

Samples collected during previous investigations of the effects of gravel extraction from an area off the east coast of England have been worked up. The results are inconclusive but are consistent with the assumption that effects on the benthos are limited to the direct effects of the head of the dredge ie effects due to the settling out of suspended materials derived from washing of the sediments. could not be detected.

Toxicological studies

The sub lethal study of the effects of low levels of mercury on Crepidula has been concluded. The programme was concluded by comparing the acute toxicity of mercuric chloride to adults and larvae. It was found that the 96 h LC50 for adults was two orders of magnitude greater than the concentration producing a sub lethal response; the latter concentration was also similar to that which inhibited the swimming and feeding of larvae during a short exposure period.

In order to monitor the effects of aqueous concentrations of organic wastes dumped at sea, the methods available have been reviewed, and practical experiments have been undertaken to determine the suitability of oyster larval development and oyster gill respiration for this purpose. The oyster larval development assay method was found to be both highly sensitive and reproducible, and a preliminary investigation in which the method was tested whilst at sea in a dumping area was highly satisfactory.

Tests have shown that the heavy metals present in sewage sludge are not available to Crangon, Cardium, Littorina and Agonus during a 30 day period of exposure. Tests up to 60 days are continuing.

Tests have continued for the purpose of approving the use of oil dispersants. These tests include simulated use of dispersants at sea and on beaches. Using selected reference dispersants the standard tests have been repeated with varying conditions and application rates. The programme has been completed and provides increased confidence in the standard procedures. During the year, discussions have been held with several other countries on the methods in use for the determination of dispersant suitability.

Tests have been made of oily-water discharges from production platforms in the North Sea. The relatively high levels of toxicity exhibited by some samples were attributed to the high salinity of the production water.

Microbiology

Investigations have been made into the cause of illness following the consumption of heat processed cockles, and improved methods have been recommended for processing. In this system a preliminary short heating period is employed for the removal of shells; after separation of the meats, washing and grading, the product is subjected to a final heat process to reduce contaminating micro-organisms.

The purification of molluscan shellfish, mainly of oysters, mussels and clams, continues to form an important part of the methods used in England and Wales for ensuring that these shellfish are suitable for human consumption. Several new plants were constructed by the fishing industry, all employing ultra-violet light. The high density tray system is finding increasing support.

The presence of PSP toxins in mussels from the north east coast was monitored during the spring and summer of 1978. Peak values of toxin reached 6 000 units/100 g for a short period over a limited area of coast. A booklet summarising 10 years monitoring since the first outbreak in 1968 has been published.

In 1978, the first known outbreak of Gaffkaemia in lobsters for 10 years occurred. Heavy losses occurred in two storage installations. The infection was believed to have been introduced by the movement into England and Wales of lobsters from other countries. The outbreaks were limited by observance of strict quarantine and disinfection of tanks, plant and equipment.

The effects of heat processing and purification on viruses present in shellfish continues to be studied. Initial experiments with MS2 phage have shown that immersion of Cardium for 1 minute in boiling water is sufficient to destroy MS 2 in the flesh, even when the numbers present initially are in excess of 10 000/g. Experiments with polio virus are continuing.

U.S.A.

1. Introduction

(J.B. Pearce)

The following is the annual administrative report from the United States to the Marine Environmental Quality (MEQ) Committee. The report is especially concerned with matters that have been considered by ICES during the past year. Special topics include: atmospheric inputs, contaminant effects, inter-calibration studies and standard methods, monitoring of biological effects, oil spill research and response programs, remote sensing programs, and the effects of sand and gravel extraction on fishery resources.

In line with the accepted format, this report does not include references to literature, but an extensive bibliography is contained in the paper "Recent Publications of Interest to the Marine Environmental Quality Committee", presented at the 67th Statutory Meeting of ICES and that paper should be consulted as a supplement to the present report.

2. Atmospheric Inputs

Considerable recent research has been conducted in regard to the input of certain toxic materials and substances from the atmosphere to the marine environment. One of the more important volumes on this subject was commissioned in 1975 and recently published by the Ocean Sciences Board, National Research Council, National Academy of Science. The volume was entitled "A Workshop on the Tropospheric Transport of Pollutants to the Ocean" and became generally available in 1976-77. Individuals in North America having special concern with atmospheric inputs included Dr. Herbert Windom, Skidaway Institute, Dr. Eric Crecelins, Battelle Northwest Research Center, and Dr. Dave Edington, Argonne National Laboratory, as well as the research personnel at the Canadian Center for Inland Waters (CCIW). CCIW has recently produced three volumes entitled "Atmospheric Loading of the Upper Great Lakes". In addition to these studies, Dr. Robert Duce has been conducting research on atmospheric inputs under funding by the Marine Ecosystems Analysis (MESA) Program of the National Oceanic and Atmospheric Administration (NOAA).

3. Contaminant Effects

Scientists working within the US Environmental Protection Agency (USEPA), the National Marine Fisheries Service (NMFS) of NOAA, US Food and Drug Administration (USFDA), and numerous state and academic laboratories have been studying the effects of specific contaminants on living marine resources.

3.1 National Marine Fisheries Service

Considerable research was done at the NMFS laboratory located at Milford, Connecticut. Biochemists and physiologists have been attempting to measure the effects of specific amounts of heavy metals on various enzyme systems and physiological responses. These scientists have developed standard methodologies which can be used aboard research vessels to measure and monitor the responses of key organisms to contaminants found at specific polluted and control stations. The development of significant baseline information will allow the assessment of pollutants on temporal and spatial bases.

Studies being done by the Milford Laboratory have emphasized the effects of inorganic substances such as heavy metals whereas scientists at the NMFS Northwest Fisheries Center, Seattle, Washington, have been conducting studies to determine the effects of petroleum and petroleum breakdown products on fish and shellfish. Their studies have, in part, emphasized the uptake, disposition, and excretion of petroleum components by several marine species. As part of their contaminant effects studies they have also investigated the manner in which hydrocarbons are metabolized by fish and shellfish and the identification of the chemical nature of metabolites which result from ingestion of petroleum hydrocarbons. They also studied the effects of oil exposure on disease resistance of salmonides and flatfish.

Research being done by the Northwest Fisheries Center includes the synergistic effects of petroleum when living resources are exposed to oils and other contaminants simultaneously. Finally, they have had specific interests in the effects of petroleum on eggs, embryos and larvae of fish which spawn in intertidal areas affected by oil.

Research related to the impacts of oil on fishery resources is also being conducted at the Tiburon Laboratory (California), Southwest Fisheries Center (SWFC).

Two programs within the Southeast Fisheries Center (SEFC) are concerned with marine environmental research. Laboratory studies underway at the Beaufort Laboratory (North Carolina) indicate that free ionic copper is the primary dissolved chemical form toxic to marine organisms. Concentrations of free ionic copper may approach toxic levels naturally for phytoplankton and fish eggs. Scientists at the Beaufort Laboratory continued to assess the effects of materials from drilling platforms in an active oil field in the northwestern Gulf of Mexico.

Scientists at the Charleston Laboratory (South Carolina), SEFC, have developed a model which predicts the probability that a given size of fish will exceed USFDA guidelines for methylmercury. Fish exceeding USFDA guidelines cannot be marketed for human consumption in the United States. The Charleston Laboratory has also developed reliability methodologies for the analyses of trace metals in seawaters so as to determine metal concentrations in surface microlayers and subsurface waters. Standard methods for analyses of PCB's and chlorinated pesticides in fish tests were established in preparation for an organic contaminants assessment program.

3.2 US Environmental Protection Agency (USEPA)

The USEPA, Environmental Research Laboratory, Gulf Breeze, Florida, has been involved in toxicological testing of pesticides, toxic organic compounds, and industrial effluents against a variety of estuarine and marine animals, chiefly algae, mysids, shrimp and fishes. The fate of toxic substances in aquatic environments was studied by the Gulf Breeze Laboratory with microcosms that use natural sediments and flow through designs. These systems emphasize integrated assessment of major degradative mechanisms which yield data on validity and adsorption/desorption, kinetics, irreversibly bound residues and their biological stability, biological degradation rates, metabolites produced and their persistence, and localization of the biological activities.

The Gulf Breeze Laboratory is also investigating the ecological effects of chemicals used in offshore drilling and production of oil and gas. These data are used in USEPA Regional Offices for developing permits for discharge of drill cuttings and fluid from oil and gas drilling rigs and production platforms. Classical toxicity bioassays are being supplemented with behavioral testing. Preliminary acute and chronic toxicity and bioaccumulation tests are being performed in the laboratory as well as at sea on test platforms.

The USEPA Bears Bluff Field Station (South Carolina) investigated effects of chromium on developing estuarine animal communities. This laboratory also studied the toxicity of 15 chlorinated and brominated by-products of chlorination to unicellular algae and oysters. Methods are being developed for maintenance and laboratory culture of the mysid, Neomysis americana, highly sensitive to low concentrations of chlorine. The shrimp, Palaemonetes pugio, is being used in studies of the toxicity of cadmium.

The USEPA Narragansett Environmental Quality Laboratory (Rhode Island) continued its physiological research on Scope-for-Growth.

3.3 Pollution and Marine Birds

Considerable research effort in the United States went into the effects of oil and other pollutants on marine bird life.

3.4 Bibliographies

Several important bibliographies on contaminant effects and specific pollutants were produced in 1978.

4. Standard Methods and Intercalibration

4.1 Standard Methods

The USEPA produced a series of volumes on standard techniques and sampling methods to be used in sampling for phytoplankton, zooplankton, marine macrobenthos, and marine fish in relation to developing quantitative baselines and monitoring programs. Another volume was concerned with procedures to be used in quantitative ecological assessments in intertidal environments. The USEPA also established standard procedures for bioassay procedures to be used in issuance of ocean disposal permits.

Scientists at the Sandy Hook Laboratory (New Jersey), NEFC, NMFS, developed a guide of standard methods for assessment of primary productivity

4.2 Intercalibration

The United States continued to participate in intercalibration exercises. Sixteen US participants were initially involved in the ICES fourth round intercalibration for trace metals in seawaters; scientists from USEPA, NMFS-NOAA, and state laboratories were involved as well as scientists from major academic institutions. Several investigators also conducted intercalibration exercises for metals, organochlorine pesticides and PCB's in biological materials. In addition to ICES sponsored intercalibration exercises, several chemical laboratories were involved in interlaboratory intercalibration exercises; environmental chemists at the NMFS Milford Laboratory, Connecticut, and the USEPA Environmental Research Laboratory, Narragansett, Rhode Island, were involved in analyses of standard samples. Finally, papers were completed on the levels of heavy metals in marine fish and shellfish per the requirements of the ICES Working Group on Monitoring and Baselines

5. Baselines and Monitoring

Activities were conducted in the US in regard to biological effects monitoring. Plans were made for a workshop at Duke University Marine Laboratory where European and North American scientists were to review and develop guidelines and protocols that would be used in biological effects monitoring. The workshop was scheduled for 26 February through 2 March 1979.

5.1 Personnel at the USEPA Environmental Research Laboratory, Narragansett, Rhode Island, reported on the Coastal Environmental Assessment Stations (CEAS) Program. The goal of this program is to assess the relative environmental condition of marine coastal ecosystems through the use of biological indicators such as the blue mussel (Mytilus edulis).

5.2 The NEFC, NMFS began the implementation of the Ocean Pulse program in 1978. This program is designed to assess and monitor changes in offshore and estuarine marine environmental quality from the Canadian border to Cape Hatteras. The program also involves monitoring using ecological, genetic, and pathobiological techniques. Three Ocean Pulse cruises were conducted in 1978.

5.3 The Bureau of Land Management (BLM) of the US Department of the Interior, completed several baseline studies designed to provide benchmarks for continued monitoring activities at proposed petroleum development sites on the continental shelf off the Middle Atlantic States and at Georges Bank. Baseline studies included the development of data from fishery assessment cruises conducted by the NMFS.

The Sandy Hook Laboratory NMFS, also began a series of cruises designed to assess and monitor levels of primary productivity, nutrients, and standing stocks of phytoplankton from the Canadian border to Cape Hatteras. These baselines are being monitored to detect changes due to pollution.

6. Oil Spill Responses and Research

6.1 Oil Spill Response Workshops

NOAA and USEPA held three workshops in Hartford, Connecticut, August 1977; Anchorage, Alaska, November 1977; and Tampa, Florida, April 1978. The results of each of the workshops were published as proceedings on oil spill ecological damage assessment. A fourth workshop was held at Philadelphia, Pennsylvania, in August 1978. The proceedings of this workshop will be published in the near future and can be obtained through this office.

6.2 Research

As indicated in Section 3 and bibliography titles, extensive research has been conducted during the past year on the effects of oil, detection of oil, and the establishment of baselines for the distribution of petroleum.

6.3 Historical Aspects of Oil Spills; Effects of Petroleum; Oil Spill Clean-up

Several investigators have been concerned with these aspects of oil pollution, and their reports are listed in the "Recent Publications" paper.

7. Remote Sensing

In recent years it has become apparent that by using remote sensing techniques or satellites, high flying U-2 type aircraft, and mid-altitude aircraft, it is possible to make measurements of pollution and environmental contamination from the air. References are presented in the "Recent Publications" paper.

In mid-1978 personnel from the NEFC-NMFS and the Langley Research Center, National Aeronautics and Space Administration (NASA), began to plan for a joint experiment in which satellites, U-2 aircraft, and mid-altitude aircraft would use remote sensing techniques to assess environmental variables along the entire eastern seaboard from Cape Hatteras to the Canadian border. Variables to be measured include chlorophyll, turbidity, temperature, phytoplankton diversity, and others. The experiment is planned for mid-April 1979. Investigators from several state and federal agencies as well as numerous academic communities will be involved. (see Figure 1).

8. Sand and Gravel Extractions

Increasing interest in marine mining for aggregate and hard minerals has resulted in growing concern for the effects of mining operations on fishery and marine resources. NOAA has, therefore, recently implemented a number of studies.

8.1 A major effort is ongoing in the US Virgin Islands where requirements for sands and gravels for construction purposes are greatly increased at the same time that limited land based resources have decreased. A major study of the effects of sand and gravel removal from Jersey Bay off St. Thomas Island is underway. NOAA also completed a major report on offshore mining in New England waters.

8.2 A review of current mining activities off the eastern seaboard of the United States was prepared providing information on recent amounts of sands and gravels removed from coastal and estuarine waters.

8.3 NOAA also has been interested in the possible effects of deep ocean mining of manganese nodules. A recent paper reviewed the pre-mining environmental conditions in an area in the North Pacific where manganese nodules exist in amounts sufficient for commercial operations, and discussed the anticipated effects of deep ocean mining. Several investigators have been concerned with the effects of dredging and spoiling activities that impact upon fishery resources in a manner similar to extraction of marine aggregates. Other relevant work is listed in the "Recent Publications" paper.

9. Modelling

Several studies were prepared in regard to modelling water quality and the impacts of contaminated waters on marine ecosystems. Again the "Recent Publications" paper provides the references.

10. Research and Regulations

Much of the recent effort by federal and state agencies has been to provide information which can be used in the development of regulations for management of marine environments and marine pollution. References to reports and papers concerned with regulation and management strategies developed in 1978 are too extensive to list in their entirety, but the "Recent Publications" paper contains a selection.

11. International Activities

Several conferences and workshops were held in the United States in relation to marine environmental quality and problems of marine pollution. In many instances, representatives from foreign governments participated in these meetings. In most instances multinational meetings involving several countries were held but in certain cases bilateral meetings were held. Of particular relevance is the first American-Soviet symposium on the biological effects of pollution on marine organisms and the US-USSR workshop on the ecology of fouling communities.

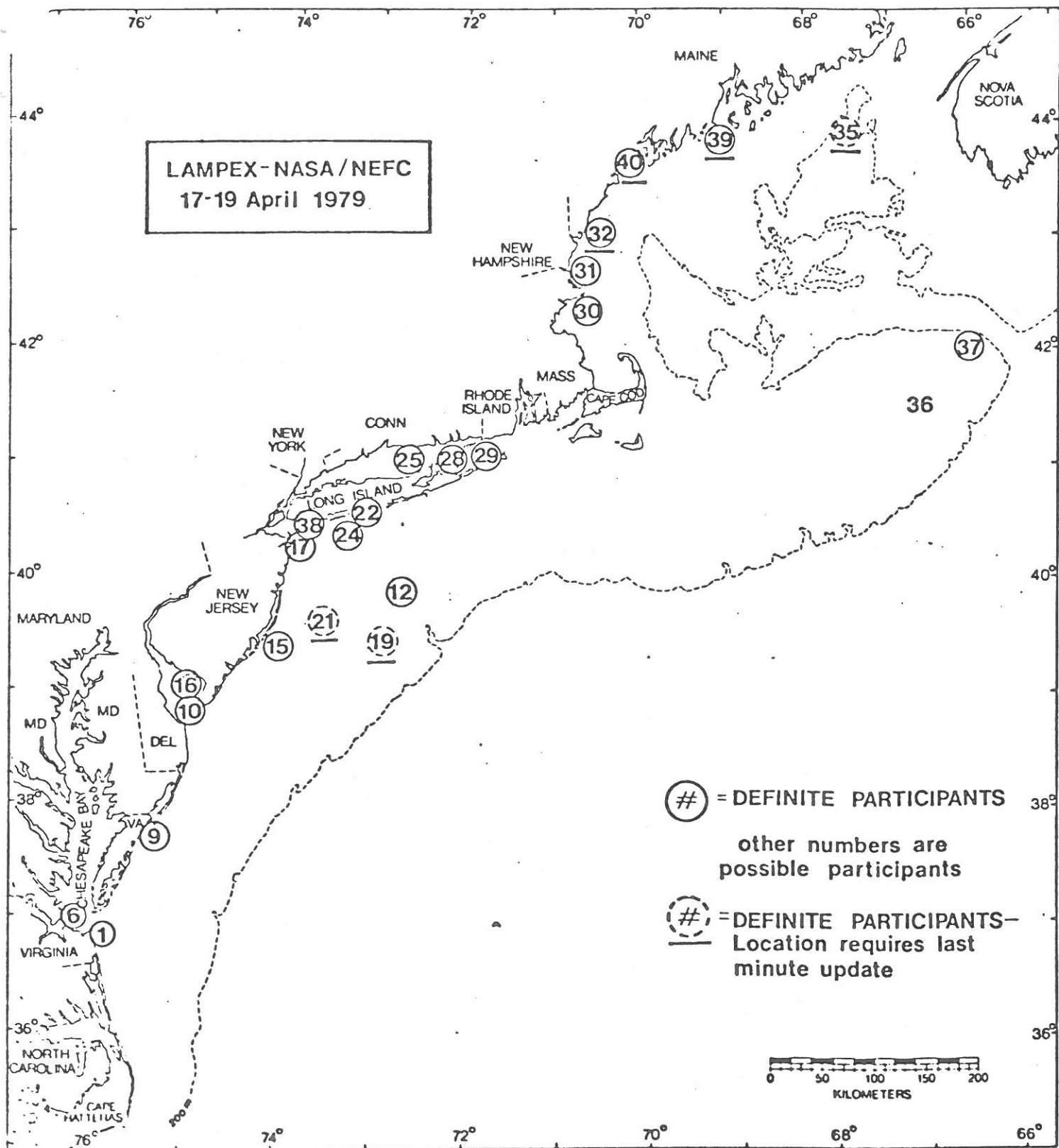


Figure 1. The Large Area Marine Productivity Experiments (LAMPEX) program involves remote sensing from satellites as well as from U-2 and mid-altitude aircraft. The operation will involve transects flown parallel to the coastline from Chesapeake Bay to the Canadian border, as well as transects flown seaward from Chesapeake Bay, Delaware Bay, and Raritan Bay. Surface vessels will carry personnel and instrumentation capable of measuring chlorophyll, turbidity, salinity, temperature, and other variables. The sea surface truth vessels are indicated by numbers.

U.S.S.R.

(N.P. Morozov and S.A. Pantin)

Biochemistry of heavy metals.

In 1978 the State Research Institute of Marine Fisheries and Oceanography (VNIRO) carried out expeditionary research in the North Atlantic. Measurements were made of the content of heavy metals (Hg, Cd, Pd, Cu, Zn, Fe, Mn, Co, Ni) in atmospheric precipitation, in the surface film of sea water and the content of suspended substance of different horizons down to 3000 m as well as in hydrobionts of hyponeuston and neuston.

On the basis of summary and statistical generalization of the results of determined metals in numerous samples of ocean fishes and plankton, which VNIRO analysed by method of atomic absorption, and the available data of scientific literature there were established positive correlation links between coefficients of metal accumulation and their ordinal numbers (atomic weight). The closest connection (correlation coefficient 0.69 - 0.77) was found for metals with ordinal numbers below 30, including Mn, Fe, Co, Cu, Zn, i.e. for biologically active microelements. On the whole, the results of the research testify to the important role of geochemical (physical and chemical) factors of metal accumulation in biomass of marine organisms.

Maximum permissible pollution.

On the basis of summarized results of toxicologic and biochemical research made by VNIRO and numerous publications (over 300) there were determined maximum permissible concentrations of the most widely distributed polluting substances in sea water, including dissolved oil products (10^{-2} mkg/l), chloride organic substances (10^{-2} mkg/l), detergents (10^{-2} - 10^{-3} mkg/l), mercury (0.1^{-1} mkg/l), lead (10 mkg/l), cadmium (1-10 mkg/l), zinc (50 mkg/l), iron (20-50 mkg/l), nickel (5-10 mkg/l), copper (5 mkg/l), cobalt (1-5 mkg/l), arsenic (5-10 mkg/l).

Laboratory research.

In 1978 VNIRO continued toxicologic study of the effect of polluting substances and sewage on marine unicellular algae (10 types), primitive organisms (2 types), plankton crustacea (2 types) and fishes (3 types). There was elaborated a system of marine toxicologic biotests for biologic control of sewage harmfulness. A new method was worked out to evaluate life disturbances of unicellular algae in culture and in situ when influenced by toxicants, where photochemiluminescence (extra low luminescence) was used.

Marine Environmental Quality Committee

Administrative Report

Appendix 1: Information about sand and gravel
extraction, 1978.

In the following is given information on sand and gravel
extraction during 1978 from:

Belgium

Canada

Denmark (also for 1977).

Iceland

Netherlands

Sweden

United Kingdom (England and Wales).

In addition, there are nil-returns from:

Ireland

Scotland.

Norway has informed that the production in 1978 was as in 1977.

MARINE ENVIRONMENTAL QUALITY COMMITTEE

REPORT ON MARINE AGGREGATE PRODUCTION FOR YEAR1978.....

COUNTRYBelgium.....

ISSUING AUTHORITYMinistry of Economic Affairs.....

REPORTING PERIOD (IF DIFFERENT FROM ABOVE)

TYPE OF MATERIAL	SIZE RANGE*	TOTAL PRODUCTION million m ³	LOCALITIES (See overleaf)
SANDS	0.063-2.0 mm	0.330	Kwinte Bank.
GRAVELS	2.0 mm-6.4 cm		
PEBBLES/COBBLES	> 6.4 cm		
CALCAREOUS SHELL LITHOTHAMNION OTHER [SPECIFY]	ALL SIZES		

*The size ranges shown here are idealized, and are intended merely as a guide to the type of categorization required.

IMPACT ON FISHERIES

A CURRENT PRODUCTION Briefly specify the types of problem encountered as a result of aggregate production during the reporting period (if any)

B FUTURE PRODUCTION Detail the quantity, type and location of any proposed marine mining activity likely to be of international fisheries interest or concern

MARINE ENVIRONMENTAL QUALITY COMMITTEE

REPORT ON MARINE AGGREGATE PRODUCTION FOR YEAR 1978

COUNTRY Canada

ISSUING AUTHORITY J. F. Uthe (source Environmental Protection Service- Atlantic Region)

REPORTING PERIOD (IF DIFFERENT FROM ABOVE)

TYPE OF MATERIAL	SIZE RANGE*	TOTAL PRODUCTION million m ³ million tonnes	LOCALITIES (See overleaf)
SANDS	0.063-2.0 mm	—	no significant
GRAVELS	2.0 mm-6.4 cm	—	mining during 1978
PEBBLES/COBBLES	> 6.4 cm	—	This does not include
CALCAREOUS SHELL LITHOTHAMNION OTHER [SPECIFY]	ALL SIZES	—	dredgings.

* The size ranges shown here are idealized, and are intended merely as a guide to the type of categorization required.

IMPACT ON FISHERIES

- A CURRENT PRODUCTION Briefly specify the types of problem encountered as a result of aggregate production during the reporting period (if any)
- B FUTURE PRODUCTION Detail the quantity, type and location of any proposed marine mining activity likely to be of international fisheries interest or concern

MARINE ENVIRONMENTAL QUALITY COMMITTEE

REPORT ON MARINE AGGREGATE PRODUCTION FOR YEAR 1977
 COUNTRY
 Denmark, København den 22. marts 1978
 ISSUING AUTHORITY
 Danmarks Geologiske Undersøgelse, Råstofgeologisk afd./Geological Survey of Denmark,
 Raw Material Department. Erik Heller
 REPORTING PERIOD (IF DIFFERENT FROM ABOVE)

TYPE OF MATERIAL	SIZE RANGE*	TOTAL PRODUCTION million m ³ million tonnes	LOCALITIES (See overleaf)
SANDS	0-4 mm	424.427	
GRAVELS	0-20 mm	533.362	
PEBBLES/COBBLES	6-300 mm	1.011.138	
Sand for land filling	m ³	3.816.755	
<u>SHELL</u>	ALL SIZES	133.350	

* The size ranges shown here are idealized, and are intended merely as a guide to the type of categorization required.

IMPACT ON FISHERIES

A CURRENT PRODUCTION Briefly specify the types of problem encountered as a result of aggregate production during the reporting period (if any)

B FUTURE PRODUCTION Detail the quantity, type and location of any proposed marine mining activity likely to be of international fisheries interest or concern

MARINE ENVIRONMENTAL QUALITY COMMITTEE

REPORT ON MARINE AGGREGATE PRODUCTION FOR YEAR 1978
 COUNTRY
 Denmark, København den 22 marts 1979
 ISSUING AUTHORITY
 Danmarks Geologiske Undersøgelse, Råstofgeologisk afd./Geological Survey of Denmark,
 Raw Material Department. Erik Heller
 REPORTING PERIOD (IF DIFFERENT FROM ABOVE)

TYPE OF MATERIAL	SIZE RANGE*	TOTAL PRODUCTION million m ³	million tonnes	LOCALITIES (See overleaf)
SANDS	0-4 mm	384.119		
GRAVELS	0-20 mm	681.292		
PEBBLES/COBBLES	6-300 mm	1.864.326.5		
Sand for land filling	m ³	1.366.969		
<u>SHELL</u>	ALL SIZES	136.986		

* The size ranges shown here are idealized, and are intended merely as a guide to the type of categorization required.

IMPACT ON FISHERIES

- A CURRENT PRODUCTION Briefly specify the types of problem encountered as a result of aggregate production during the reporting period (if any)
- B FUTURE PRODUCTION Detail the quantity, type and location of any proposed marine mining activity likely to be of international fisheries interest or concern

MARINE ENVIRONMENTAL QUALITY COMMITTEE

REPORT ON MARINE AGGREGATE PRODUCTION FOR YEAR 1978

COUNTRY Iceland

ISSUING AUTHORITY Marine Research Institute, Reykjavík

REPORTING PERIOD [IF DIFFERENT FROM ABOVE]

TYPE OF MATERIAL	SIZE RANGE*	TOTAL PRODUCTION million m ³	million tonnes	LOCALITIES (See overleaf)
SANDS	0.063-2.0 mm	0.110		Faxa Bay
GRAVELS	2.0 mm-6.4 cm	0.255		Faxa Bay
PEBBLES/COBBLES	> 6.4 cm			
CALCAREOUS SHELL LITHOTHAMNION OTHER [SPECIFY]	ALL SIZES	0.100		Faxa Bay

*The size ranges shown here are idealized, and are intended merely as a guide to the type of categorization required.

IMPACT ON FISHERIES

A CURRENT PRODUCTION Briefly specify the types of problem encountered as a result of aggregate production during the reporting period [if any]

B FUTURE PRODUCTION Detail the quantity, type and location of any proposed marine mining activity likely to be of international fisheries interest or concern

Netherlands

Annual Report on marine sand extraction in the Netherlands sector of the North Sea for 1978 to the Marine Environmental Quality Committee (C. Res. 1974/4: 22 and C.Res. 1974/4:24ii).

Extracted Sand

During 1978, 16 licences were given to the industry to extract marine sand.

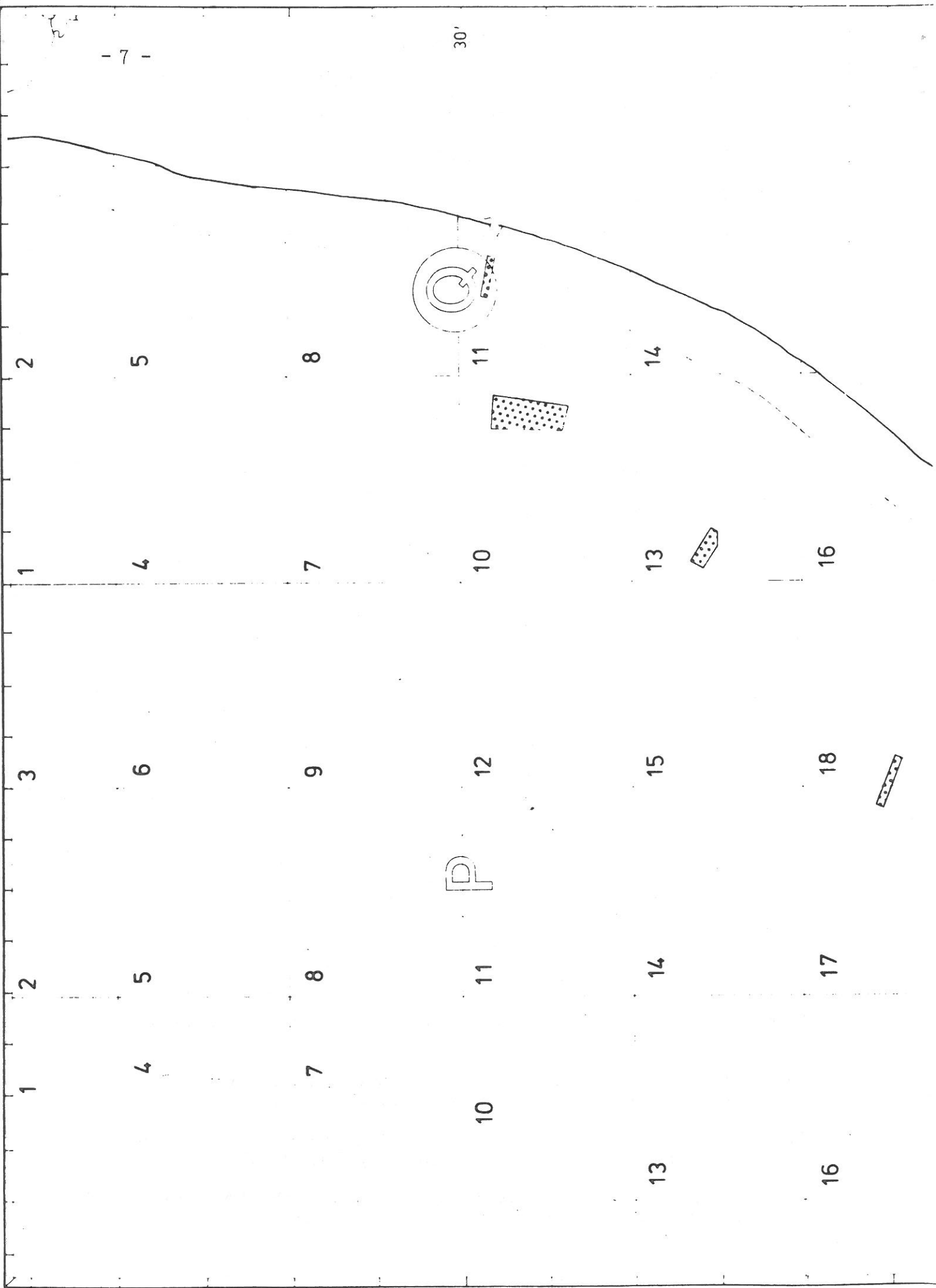
Licence nr.	Area	Approved amount m ³	Actual extracted m ³
1	S4	150 000	131 429
2	S7	150 000	123 342
3	Q13	100 000	
4	S5	100 000	1 714
5	S7	50 000	1 519
6	Q13	100 000	
7	S5	50 000	6 969
8	S7	50 000	7 653
9	Q13	50 000	
10	S4	100 000	55 405
11	Q10	2 000 000	152 095
12	P18	100 000	
13	Q11	2 065 000	1 801 982
14	A12	450 000	85 805
15	P17	600 000	64 706
16	Q10	<u>500 000</u>	<u> </u>
		<u>6 715 000</u>	<u>2 432 619</u>

From the Maasgeul 651 908 m³ was extracted for the protection of the coast of Hook of Holland.

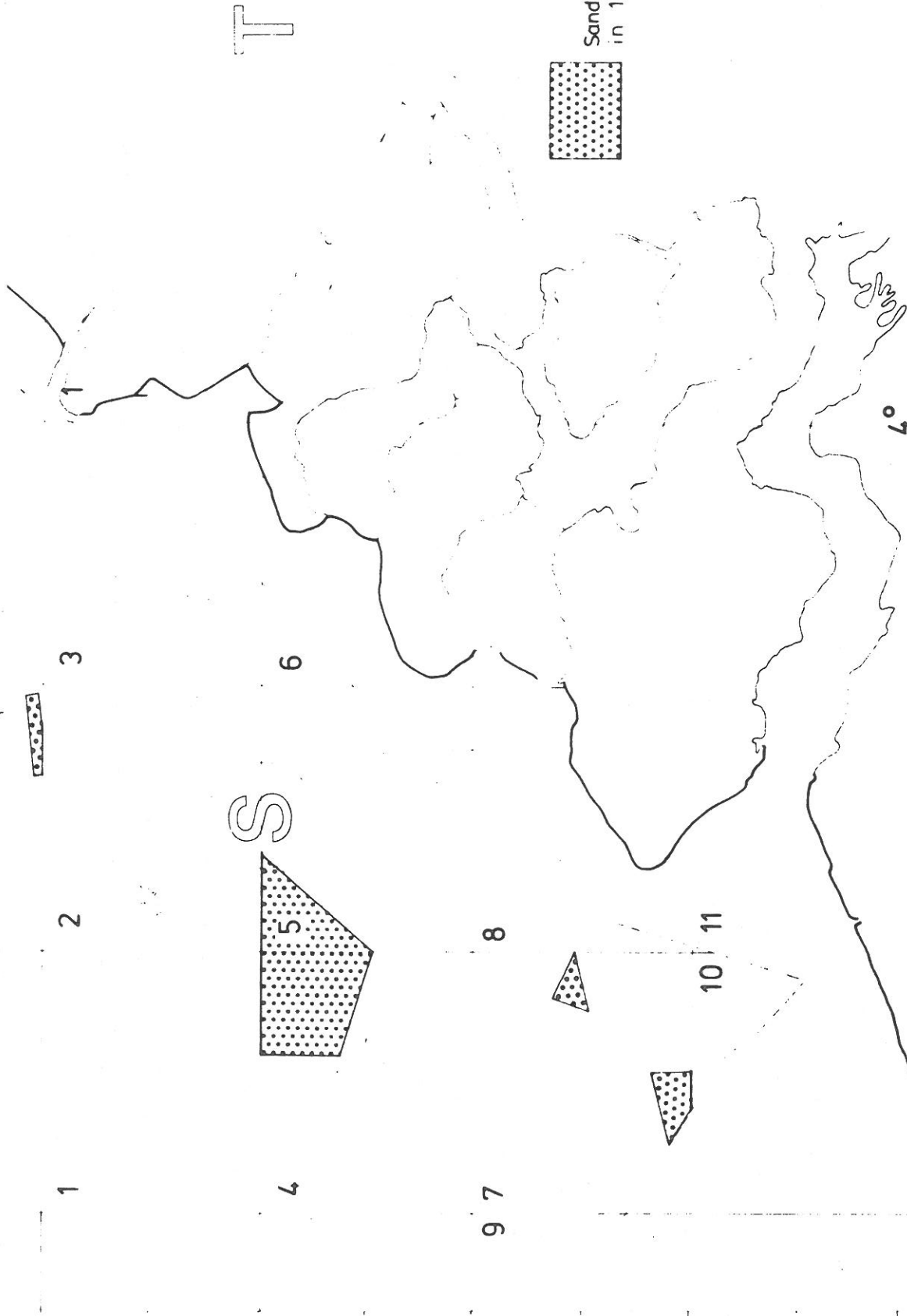
From the Maas and Eurogeul 208 640 m³ has been supplied for bottom protection of channels in the Rotterdam Waterway Area.

From the Maasgeul 60 301 m³ has been dumped in the so-called storage yard kilometresector 1016 of the New Waterway near Maassluis.

The total marine sand supply from the Dutch part of the North Sea in 1978 has been $2\,432\,619\text{ m}^3 + 651\,908\text{ m}^3 + 208\,640\text{ m}^3 + 60\,301\text{ m}^3 = 3\,353\,468\text{ m}^3$. ✓




52°



Sand extraction areas
in 1978.



NETHERLAND PART OF THE CONTINENTAL SHELF AREAS FOR EXTRACTION OF MARINE AGGREGATES		BIJLAGE	
	RIJKSWATERSTAAT DIRECTIE NOORDZEE	GEC. GET. GEZ. ACC.	SCHAAL 1:500 000
		Bladz. 1	A 3 NR. 79 141

30'

3°

The maps are identical
with those of previous year.
Of C.M. 1978/E:2

MARINE ENVIRONMENTAL QUALITY COMMITTEE

REPORT ON MARINE AGGREGATE PRODUCTION FOR YEAR 1978

COUNTRY Sweden

ISSUING AUTHORITY Fishery Board

REPORTING PERIOD (IF DIFFERENT FROM ABOVE)

TYPE OF MATERIAL	SIZE RANGE*	TOTAL PRODUCTION million m ³	LOCALITIES (See overleaf)
SANDS	0.063-2.0 mm		Sandflyttan, Västra,
GRAVELS	2.0 mm-6.4 cm	58 889	Haken, Outside Ystad
PEBBLES/COBBLES	> 6.4 cm		(all Southern Sweden)
CALCAREOUS SHELL LITHOTHAMNION OTHER [SPECIFY]	ALL SIZES		

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Very local impact on fisheries being prevented where marine aggregates are taken.

Not known, but will for 1979-1980 probably be of the same order.

ICES FISHERIES IMPROVEMENT COMMITTEE

REPORT ON MARINE AGGREGATE PRODUCTION FOR YEAR 1978

COUNTRY ENGLAND AND WALES

ISSUING AUTHORITY CROWN ESTATES COMMISSIONERS

REPORTING PERIOD [IF DIFFERENT FROM ABOVE] 16 JAN 1978 - 15 JAN 1979

TYPE OF MATERIAL	SIZE RANGE*	TOTAL PRODUCTION million m ³	LOCALITIES (See overleaf)
SANDS	0.063-2.0 mm	(A1 A2 A5 A51 B2
GRAVELS	2.0 mm-6.4 cm	9.8	C8 C51 D51 E5 E6 F2
PEBBLES/COBBLES	> 6.4 cm	(F3 F4 G4 XX53 ZZ2
CALCAREOUS SHELL LITHOTHAMNION OTHER [SPECIFY]	ALL SIZES	NONE	

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IMPACT ON FISHERIES

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